

POPULAR SCIENCE

JULY 1962 • 35c

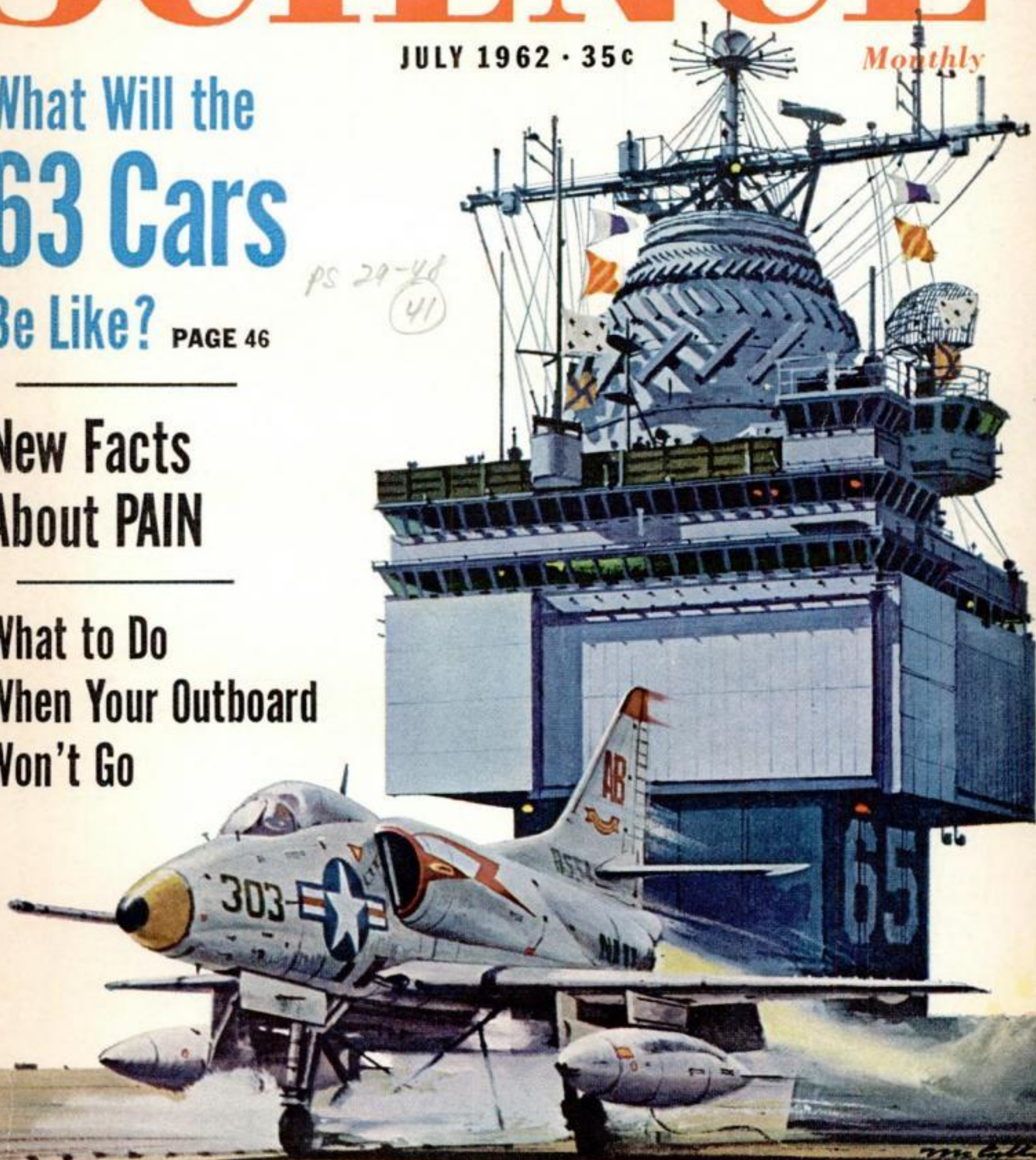
Monthly

What Will the
'63 Cars
Be Like? **PAGE 46**

PS 29-48
41

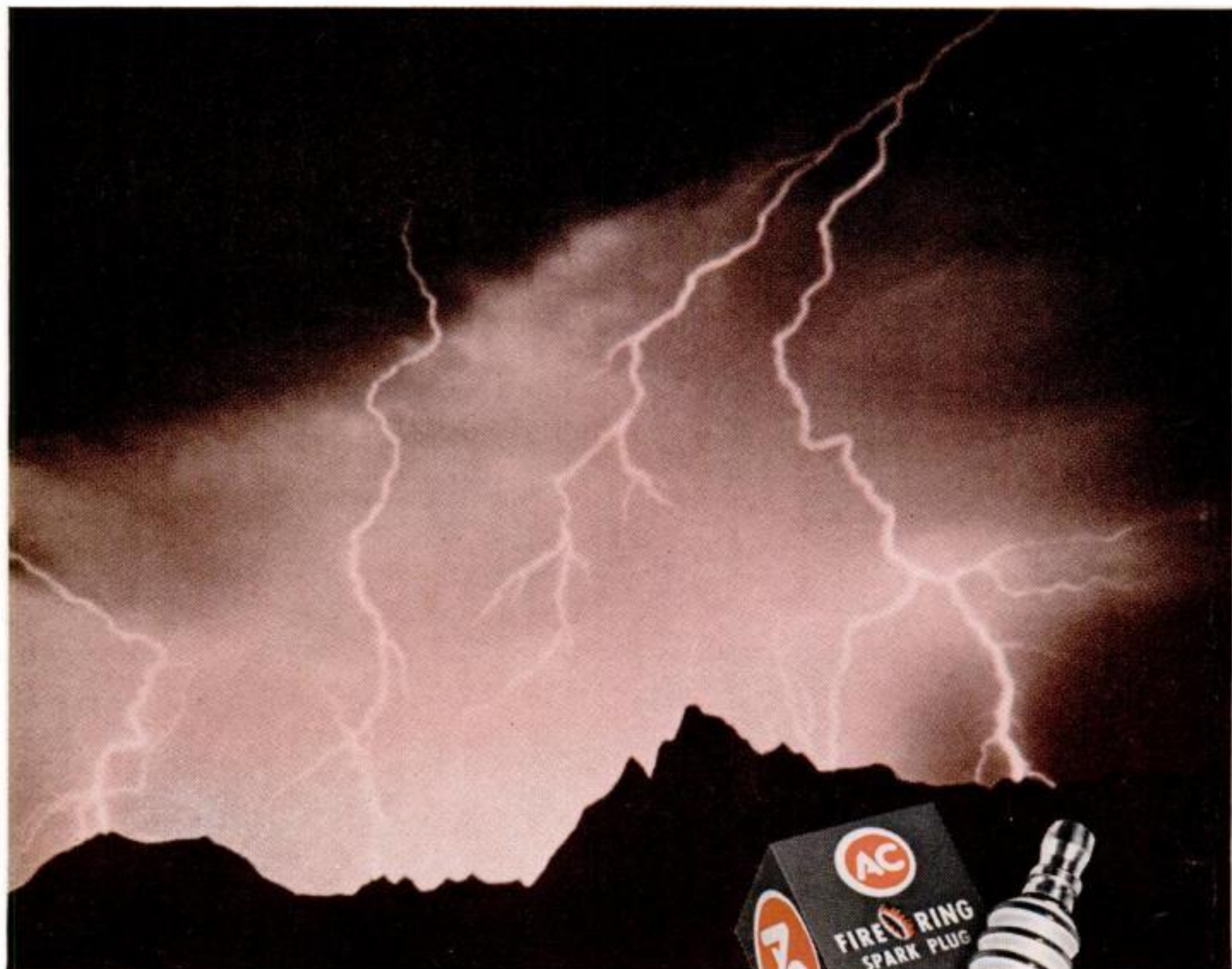
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Vol. 181 No. 1

Popular Science

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MONTHLY

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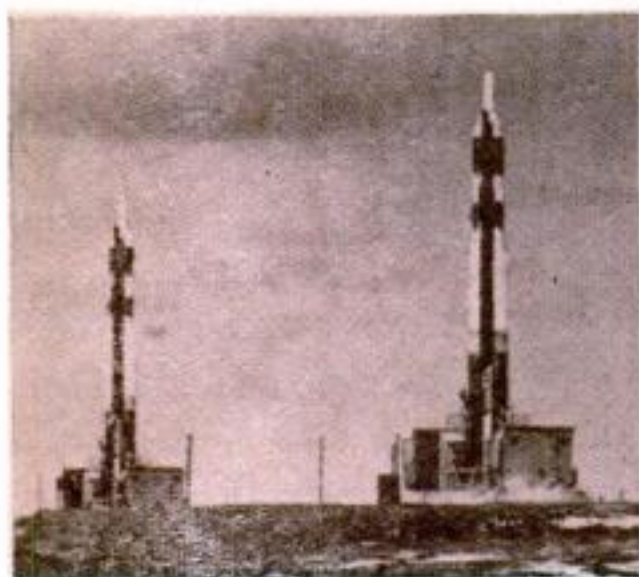
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July 1962

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How ready are our giant missiles?
How safe from accidents, mistakes,
maniacs? Full report on page 35.

Are redheads more
sensitive to pain
than blonds? Could
be. See page 40.



SPACE AND AVIATION

[Underground with the Titan • 35](#)

[Around Space in 12 Minutes • 74](#)

[Back-Seat Driver of the B-58 • 76](#)

CARS AND DRIVING

[What's Coming in the 1963 Cars • 46](#)

[Jeep Gets Overhead-Cam Engine • 73](#)

[I Drove My Car 100,000 Miles • 82](#)

[No-Wheels Truck to Go Anywhere • 96](#)

[What's New for Your Car • 159](#)

SCIENCE AND INVENTION

[What We Know About Pain • 40](#)

[How to Dress for 70 Below • 44](#)

[How to Get Out of the Woods • 50](#)

[I Watched Them Plug the Nile • 54](#)

[How Old Is It? • 85](#)

[Last Chance to Save the Bald Eagle • 99](#)

SPECIAL REPORTS

[85,000-Ton Hot Rod • 58](#)

[The Job That Scares Everybody • 67](#)

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HOME AND SHOP

- [Low-Cost Home Shop Tools • 106](#)
- [Spot and Dig Your Own Pond • 121](#)
- [Our Living-Room Doghouse • 123](#)
- [Those Wonderful Plastic Varnishes • 145](#)
- [A Man-Size Lawn Bench • 149](#)
- [What's New in Tools • 150](#)
- [Oil and Water Mix in New Paint • 156](#)
- [What's New in Home Improvements • 157](#)

ELECTRONICS

- [TV Antennas Go Electronic • 126](#)

AUTO REPAIRS

- [Do-It-Yourself Body Repairs • 102](#)
- [Hints from the Model Garage • 162](#)
- [Gus Picks Up Three of a Kind • 164](#)

BOATS AND MOTORS

- [If Your Outboard Conks Out • 110](#)
- [What's New in Boating • 153](#)

PHOTOGRAPHY

- [Home Movies That Talk • 140](#)
- [Picking the Right Film for the Job • 144](#)
- [What's New in Photography • 155](#)

PICTURE NEWS

- [Train Travels on 10-Foot Tires • 52](#)
- [Telephone for the Hard-of-Hearing • 79](#)

SHORT CUTS AND TIPS

- [Table Saw for Metal Cutting • 119](#)
- [When a Door Binds on the Sill • 119](#)
- [Vacuum Cleaner for Plastic Pools • 120](#)
- [Mending a Rip in Old Canvas • 122](#)
- [How to Balance an Electric Fan • 130](#)
- [A Spot Weeder Made from Scraps • 139](#)
- [Storage Box for Ferrotypes Plates • 139](#)

EVERY MONTH

- [PS Readers Talk Back • 6](#)
- [The March of Science • 17](#)
- [Detroit Report • 26](#)
- [I'd Like to See Them Make • 89](#)
- [The Other Fellow's Job • 90](#)
- [New Ideas from the Inventors • 93](#)
- [Wordless Workshop • 124](#)

POPULAR SCIENCE **90th** YEAR



He can crash-dive on his prey at 100 m.p.h. Can he outfly his doom? Facts on the bald eagle, page 99.



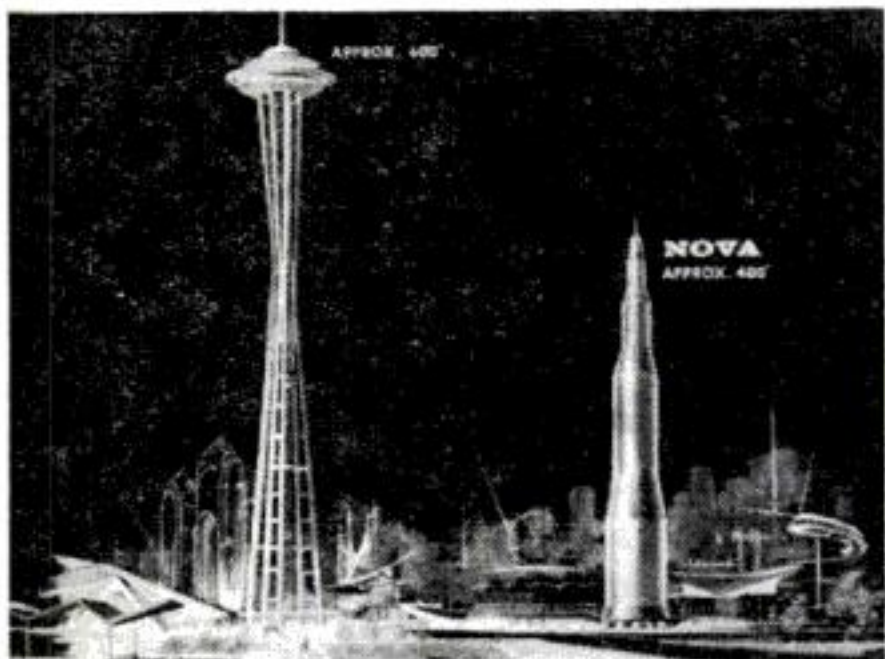
Better picture . . . no snow . . . one new channel (says PS report) with electronic antenna. Page 126.

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Space Is Here to Stay!

AS THIS is written, I have just returned—in 4 hours and 11 minutes—from Seattle to New York. I was in Seattle to view the World's Fair, and to attend the Second National Conference on the Peaceful Uses of Space. The Fair is worth seeing if only to ride on the Monorail, view Puget Sound from the glass-windowed elevators of the Space Needle—America's answer to the Eiffel Tower—and to visit the science exhibits.

As for the Space Conference: I arrived with a "show-me" attitude; I came away a convert. The top scientists of Uncle Sam's National Aeronautics and Space Administration made a believer out of me.



Space Needle and Nova at Seattle Fair are shown in artist's conception. You won't see Nova in actuality because it hasn't been built yet.

Just hearing brave men like Lt. Col. John Glenn Jr.; Capt. Joseph Kittinger, who jumped 102,000 feet from a balloon; and Joseph A. Walker, who only the week before had flown the X-15 to a height of 255,000 feet, was thrill enough. Even more memorable was meeting Dr. Wernher von Braun, the world's greatest expert on rockets. In years to come, I'll look back on this as one might who had met Orville Wright or Thomas Edison. In the history of science, this unassuming German-born American will loom that large.

The conference left three strong impressions on me:

First was the overwhelming confidence of the spacemen. If we can send one man into orbit, we can send two. If we can put them in orbit, we can send them to the

moon. If we can go to the moon, we can come back. If we can build boosters like the Atlas, with a thrust of 362,000 pounds, we can build the Nova with 12 million pounds of thrust—and a weight equal to 50 Boeing 707s.

Asked about "rendezvousing"—the coupling together, like box cars, of capsules—in space, with astronauts crawling around on the outside like brakemen, Dr. von Braun described the maneuver as simple. "So what if it takes two or three orbits to get them hooked together? It's not nearly as complicated as the Nike-Zeus problem, where you have to hit—rendezvous with—an ICBM and destroy it . . . and we've solved that."

My second impression was the inevitability of an "explosion" in space knowledge. The rear seats and balconies of Seattle's giant Opera House were packed with high-school students, who lined up six deep at aisle microphones to ask questions. Today's astronauts and engineers grew up in ignorance of space. Tomorrow's crop is starting out committed to the exploration of space before they're out of high school.

My third impression is that space may indeed be man's long-sought "moral equivalent of war." The U.S. and the USSR may become so engrossed in exploring other planets that they won't risk obliteration on this one. Like war, space requires intense dedication to a common goal. Like armament-building, it demands productivity. And it is "good for business." Like war, it uses up most of its weapons, or tools, as fast as they are created. But instead of destruction, it opens the curtain on the greatest adventure in Man's history—the peaceful conquest of the universe.

Robert P. Crossley
EDITOR

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PS readers talk back



In Praise of Automatic Chokes

After nearly 40 years, I again own a car with an automatic choke: a 1961 Rambler Classic sedan. You can tell Mr. Benner ["PS Readers Talk Back," Mar., p. 50] that this car, standing outdoors most of last year's long, cold, snowy winter, always started promptly.

I'll admit I've seen trouble in this community, in the winter time, with automatic chokes. If I were making cars, I'd make hand chokes an option. Even my new Rambler will stall, with the choke still on, until it heats up. The trick is not to give it much gas until the heat comes on enough to reset the choke.

S. S. GILLAM, Minneapolis.

He Knows His Computers

The article telling how your new electronic computer handles PS subscriptions [May, p. 28] was very interesting. But you say there is no way to handle pre-formed type at a rate of 600 lines per minute. The IBM 1403 printer, used on type 1401 and larger 1410 computers, can print lines (of up to 132 characters each) at 600 lines per minute for alphamerial (numerals and alphabetical letters) characters. With a simple change, it can print 1,285 lines per minute of numerical information.

The IBM 1403 attains these printing rates with a continuous revolving chain containing pre-formed type.

PAUL K. DUER, Vestal, N.Y.

A State of Pleasure

We were very pleased to see the article on the Iron Mike ["The Hacksaw Your Drill Can Drive," Apr., p. 151], a tool devised by one of this state's most outstanding citizens. The thorough detail and fine pictures made it a most outstanding production.

L. A. SCHNEIDER, Director
Economic Development Commission
Bismarck, N. D.

Bunching and Zipping

The traffic pacer that Martin Mann describes ["The March of Science," Apr., p. 23] seems potentially dangerous. Instead of "bunching up cars"—a major cause of chain-reaction collisions—those signs should simply show at what speed to continue in order to make the light, or should merely flash "stop ahead."

You say the pre-signal "gives cars a running start. They are stopped early so that they have room to accelerate and zip across the intersection at the top speed." Since when has it been sensible to zip through any intersection? And what about the poor driver who wants to turn off? He'd hold up a whole platoon!

Instead of more lights, let's have more efficient management of the existing ones.

BRUCE P. KIRK, Baltimore.

Blooper

In your "Detroit Report" for April [p. 70] you make the statement that "The 1963 Buick will offer as standard equipment the Roto Hydra-Matic transmission now used by Oldsmobile and Pontiac, according to a reliable source at GM's Transmission Division."

Your "reliable source" is completely off base. I can say unequivocally that we will have in 1963 the same Turbine Drive (Dynaflow) transmission—the smoothest on the market.

G. H. RIDEOUT, Director Public Relations
Buick Motor Division, Flint, Mich.

Holed Up—While the Cops Roll

Congratulations on "What Happens When You Call the Cops" [Apr., p. 100]. One thing worries me: After committing a crime and returning to his hideout, couldn't the criminal listen in on the local police frequency and find out exactly what the police know about his crime and what description of him, if any, they had? Or is this type of radio hard or impossible to come by in Chicago? If he had such a receiver, the criminal could follow the progress of the search and successfully evade it.

W. O. DETWILER, Hasbrouck Hts., N.J.

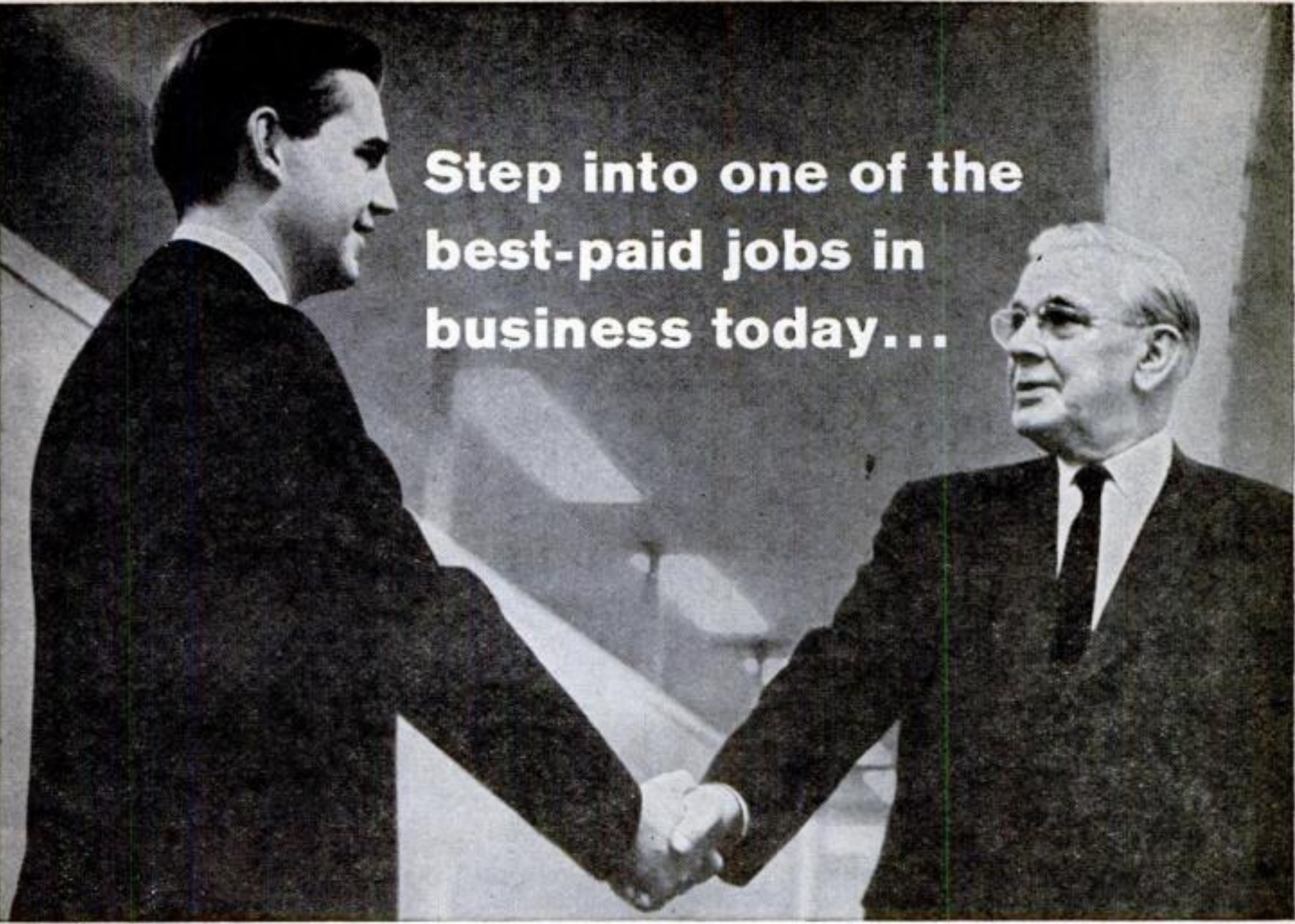


Theoretically, he could listen—if he knew what frequency the police were operating on and had equipment at hand to receive this frequency.

For Wholesale Stamp Collectors

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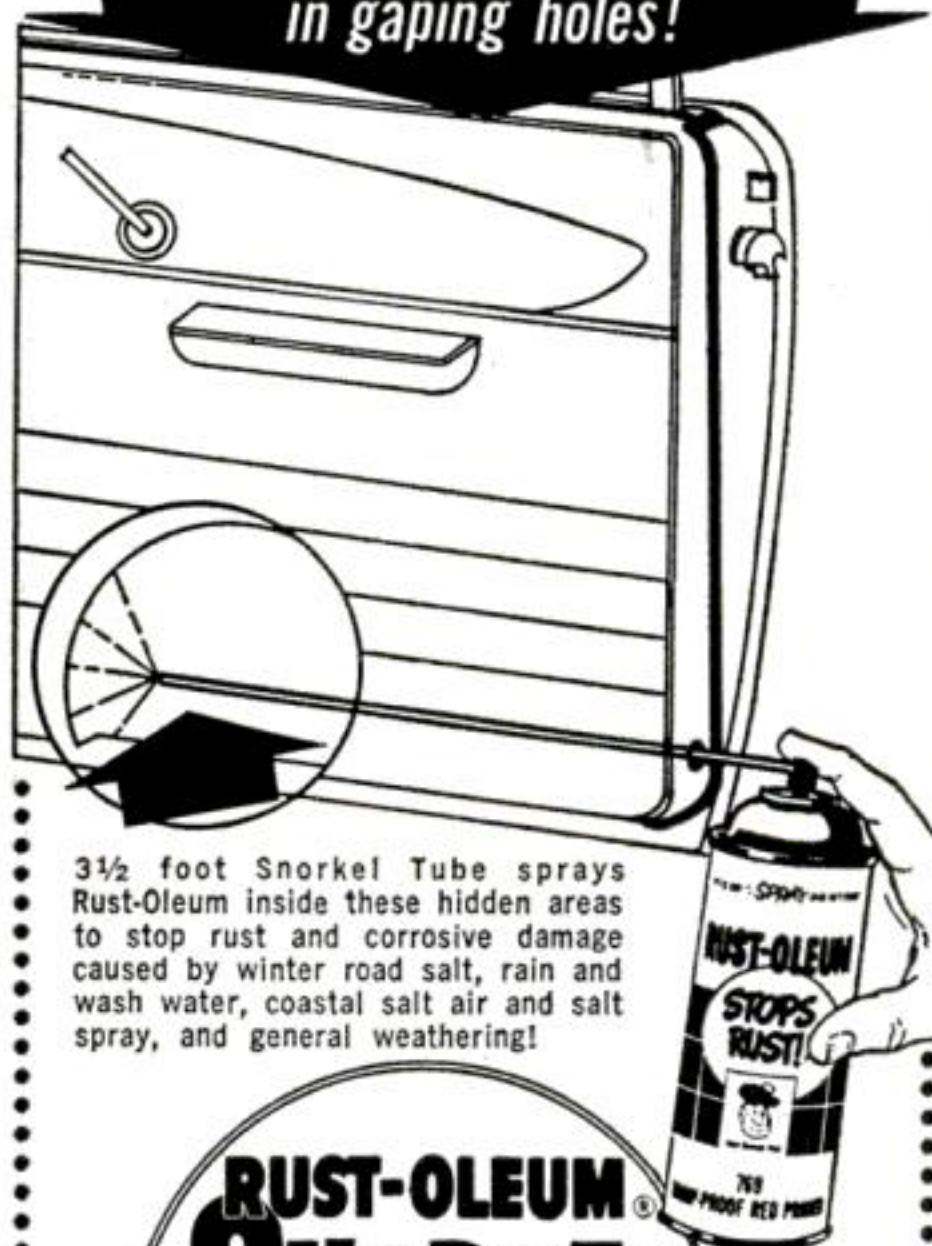
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Timber!

I liked "Clues to Cars to Come" [Apr., p. 120], but tell me: Suppose you are driving a Mercury Palomar and suddenly there's a low



branch. What happens to the person in that raised back seat?

PETER PARSLOW, Bayville, N.Y.

More on Rifle Cleaning

The letter about rifle-bore cleaners [Apr., p. 16] took me back to the days of World War I. On the Somme in 1918, we used the S. M. Lee-Enfield. It had a cylinder of bronze gauze that was pulled through from muzzle to breech. On battle-fouled rifles, this really got the stuff out of the bore without belling the muzzle. We liked the cleaner so well that we adopted it for our own 30'06 rifles—when we got them back again. To this day, I use a similar device on my 30'06 Match with no injury to the bore.

REESE NELSON, Phoenix.

Shutter Snapping with Binoculars

I enjoyed "Shooting Telephotos with Binoculars" [Apr., p. 195] as it told me how I took a 3-D shot through both barrels of 7X50 binoculars trained on a distant glacier in Grand Tetons National Park last fall. My Stereo Realist was balanced (without benefit of the McCafferty bracket) atop my old Chevy. My wife helped in the balancing act.

O. W. STENSLARD, Burbank, Calif.

Wising Up an Expert

Looks like what Mr. Reynolds thought was "common knowledge" about car keys and their codes is not so common after all. Judging by his letter ["PS Readers Talk Back," Mar., p. 20], he's mightily confused. Let me fill him in:

General Motors codes, to which he evidently refers, range between 8,000 and 9,499. This affords 1,499 changes, not 9,999 as our friend


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truck tires are
too worn
for the
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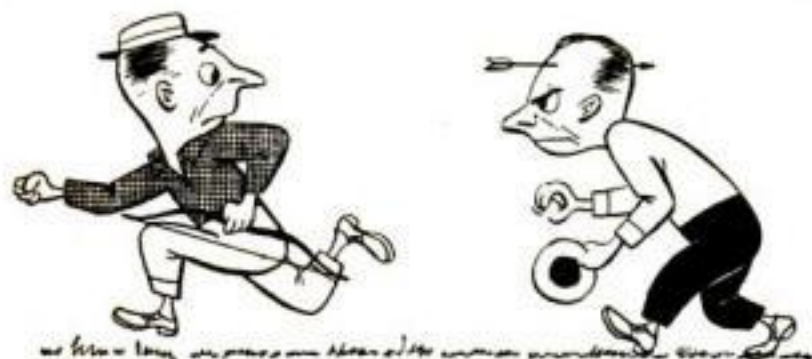
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says. The numbers are for reference to a code book which lists the cuts for each number—the key number does not supply that information. The key is cut with a special code machine. O. M. HOUSE, Los Angeles.

The Bow and the Flu-Flu

In "Skeet Shooting with Bow and Arrow" [Mar., p. 106], you show an archer shooting at a thrown target. The man throwing the target is only a few degrees out of the line of fire. If the target went straight up and your archer



missed—even with those special flu-flus—*wham!* That archery company had better perfect a machine to replace the helper when he retires for first aid.

CHARLES MCWILLIAMS, Aurora, Ill.

When Repairmen Get Together

Art Margolis' TV repairs are always interesting, but the one on series-wired tubes ["Fixing

TV's Dead Heats," Mar., p. 149] doesn't always work. One set I got stuck with, as a TV repairman, had just enough tubes for a 110-volt line. Because of higher line voltage during the day, neither the 12AX4GT nor the GTA could take the surge.

Putting a resistor before the 12AX4 cured the trouble. My argument here is that these sets should have been wired for a 120-volt line. All TV receivers of this type I now repair this way for safety. Some sets will operate on a tube with higher filament voltage.

PETER LEGON, Malden, Mass.

Signaling the Flashy Driver

One of your readers suggests flashing turn signals alternately to get the guy that's asleep to turn his off ["PS Readers Talk Back," Apr., p. 8]. I prefer my lazy way: I rigged an alternate flasher from a fire-engine-equipment house under the dash. This permits flashing the rear signals. There's hardly time to signal an approaching car with front signals. There is a bonus: You couldn't find a better emergency-warning signal.

If car manufacturers made the lights on the dash larger and brighter, and the audible click loud enough to be heard over radio, heater, whistling vents, and a squalling child . . . but that might be too much to expect.

H. C. WIERSDORFER, Hamburg, N.Y.



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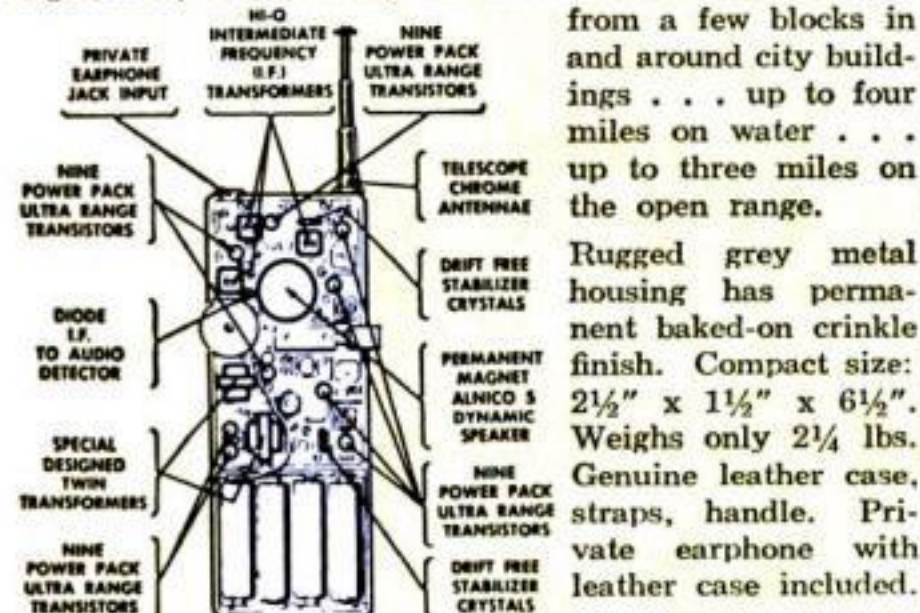
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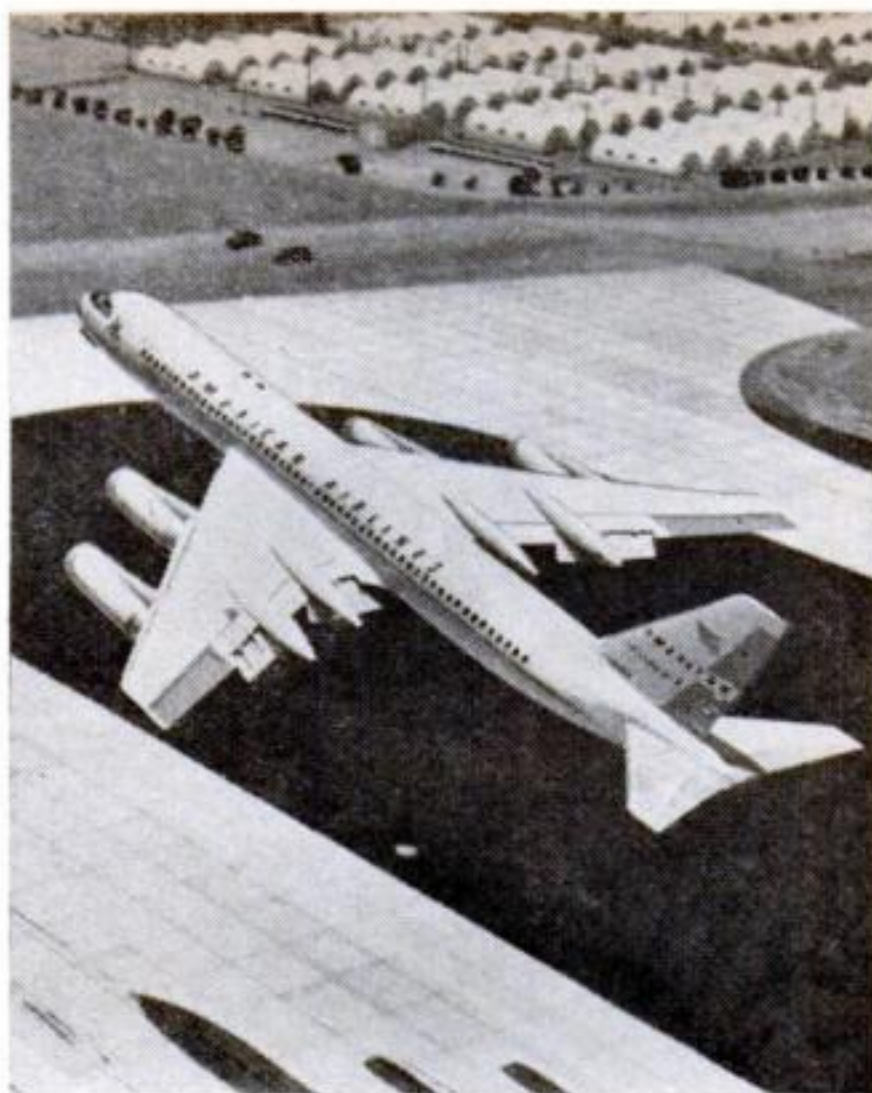
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A Convair 990 jet takes off

This unusual view of a plane taking off was photographed from a helicopter as the four-jet Convair 990 rose from Lindbergh Field in San Diego, Calif. Protruding from the trailing edge of the wings are speed capsules that reduce drag at high speeds. The 990 cruises at 640 m.p.h.



Pedal-powered school bus

Youngsters attending nursery school in Keelung on the Nationalist Chinese island of Taiwan reach their classes in a three-wheeled pedibus. Bars at the windows keep them from tumbling out as their driver pedals as fast as his legs can pump. Most people on the 85-by-225-mile island get around by bicycle, with six factories there turning out 60,000 bikes a year.

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Justin Smith Morrill

How a 100-Year-Old Law Aids Science Today

A HUNDRED years ago this month while the North was suffering its first bloody defeats in the Civil War, President Lincoln took time out from the crises of the day to sign a bill that was to reshape the American way of life. The Morrill Land-Grant Act was as neat a bit of visionary—and reform—legislation as had ever fought its way through five years of political wrangling and one veto (by President Buchanan). Its vision?

- To provide education for all—not just the rich and privileged few.
- To educate them in new fields—applied science, mechanics, engineering, and agriculture—as well as the traditional “big three” professions of the day: the law, the ministry, medicine.

It would do all this and at the same time correct an abuse: the waste of public lands. The vast acres owned by the federal government were cheap and easy to acquire. What speculators didn't snatch up, farmers—untrained in soil care—were fast despoiling.

The Act arranged for the allotment of government land to the states—30,000 acres for each member a state had in Congress. The states merely had to sell the lands and use the money to set up at least one public college.

Today there are 68 land-grant schools. You know them as Massachusetts Insti-

tute of Technology, Rutgers, Virginia Polytechnic Institute, the Universities of California, Minnesota, Wisconsin, Illinois, Iowa State, Purdue, to mention some. There is at least one school for every state in the Union and in Puerto Rico.

The discovery of streptomycin; the synthesis of vitamins; the development of hybrid corn, the television tube, the transistor, the first atom smasher; the production of uranium and of rocket fuels—all resulted from research carried out at these schools. Twenty-four American Nobel Prize winners alive today were educated at land-grant schools. Forty percent of all Ph.D. degrees in this country have gone to land-grant scholars (55 percent of the biology degrees; 43 percent of those in the physical sciences; *all* degrees in agriculture; 53 percent in engineering; 35 percent in mathematics).

Today the schools have adult extension programs and agricultural experimental stations. An original proviso that military science should be part of the curriculum (but not a requirement) led to the Reserve Officers Training Corps program—which the late General George C. Marshall credited with speeding up this country's mobilization in World War II by six months.

Ironically, Senator Justin Smith Morrill, who authored the bill, had had to quit school at 15. This stern, handsome Vermonter, the son of a blacksmith, got his political training from the give and take of managing a general store. At 38 he retired from storekeeping, and a few years later went to Washington where he served 44 years in Congress—first in the House and then in the Senate. He was a believer in high tariffs, which led a Virginia newspaper to offer \$25 for him, dead or alive.

A true son of New England, he was a man of thrift. But the thrift stopped short when it came to education. Morrill's fondest dream was to see that others would get the education his parents couldn't afford to give him—and he had the zeal to make the dream come true.



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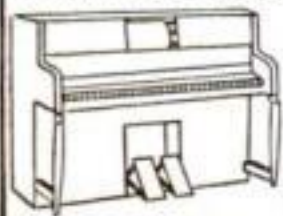
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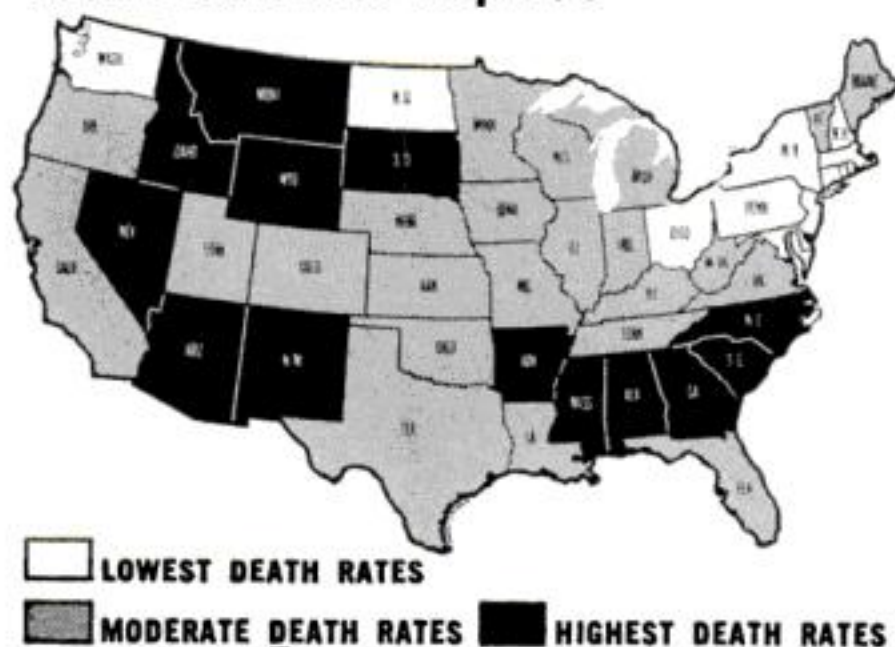
The march of SCIENCE

By Martin Mann

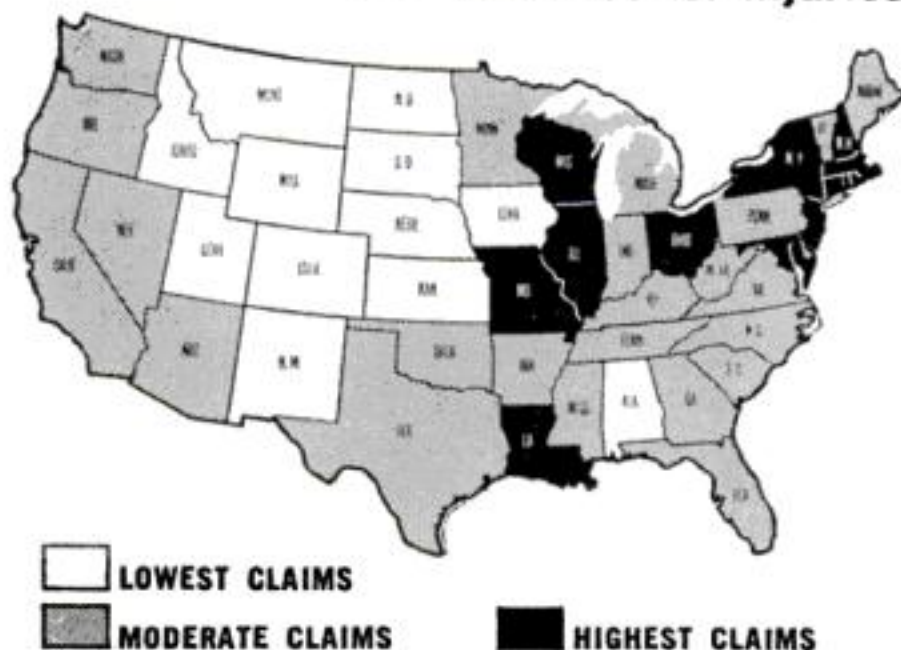
Cars kill in the West and South

Whether you get killed or not in a bad auto crash depends on where you live. This strange fact emerges from a new study of

Auto Death-Rate Map . . .



. . . Reverses for Injuries



but this may reflect the improvement in surgery more than it does safer driving.

World's best pump: a tree

After 70 years of research, scientists are still stumped by a natural puzzle that seems simple but turns out to be very complicated: What makes sap rise in trees? Some trees are 300 feet tall; their roots go nearly that far down into the ground. They don't appear to have mechanical pumps like the hearts of animals. Yet somehow they lift water up to the leaves at their tops. How?

The best explanation yet for the rising of sap is the wick theory: Water evaporates from leaves and pulls the sap behind it up through the tubes. This raises the problem of tensile

insurance statistics reported by the National Safety Council. Death rates (per car in use) are low in the New England, Mid-Atlantic, and Pacific Coast areas. They are high in the mountain and southern states. Even stranger, injury rates—as measured by insurance claims—follow the reverse pattern. They are high in the Northeast and part of the Midwest, low in the mountain and plains states. The reason why is anybody's guess.

More ominously, the national injury rate has climbed slightly over the past few years (2.71 claims paid per 100 cars insured in 1959 to 2.76 in 1961). In some states the rate has gone up sharply (from 2.04 to 2.46 in Wisconsin, for example). Nobody knows the total number of auto injuries; this study estimates 1,500,000 claims, all told, in 1961. The number of deaths has remained fairly steady (40,000 annually) for several years,

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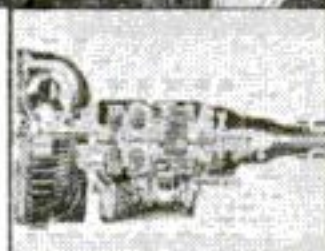
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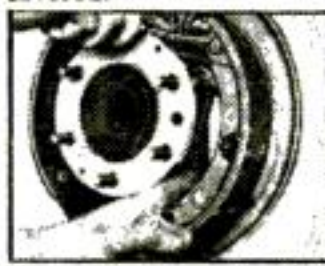
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The March of Science . . . continued

strength. If the sap stream breaks under this pull, you get vapor lock, which blocks the flow of sap just as it blocks the flow of gasoline in a car engine. The pull must be very strong—20 times atmospheric pressure at the top of a tree 300 feet tall (this is an estimate because nobody has figured out a way to measure the tension directly). Lab tests show that bubble-free water has an amazing tensile strength. The column of liquid doesn't break apart even under a pull 260 times atmospheric pressure.

The gimmick is "bubble-free." When water freezes, all the air that had been dissolved in it becomes bubbles. The sap in northern trees freezes every winter. Those sap tubes must be full of bubbles—a massive vapor lock. This is why the sap runs down from maple trees when they are tapped (sap tubes punctured) during the first thaw. But it doesn't explain why *all* trees do not run sap in the spring (only maples and a few others do). Nor does it explain why maple sap stops running down and starts climbing up again. The great vapor lock caused by winter freezing has to be overcome somehow.

One clue to the mystery has now been found by Prof. Ralph H. Kurtzman of the University of Rhode Island. It turned up in Dutch elm disease, which makes leaves wilt dry even when the ground is wet—evidently the sap-lifting is stopped. Recently Professor Kurtzman extracted from Dutch elm fungus a chemical that blocks the action of ATP (adenosine triphosphate). Branches wilted when put into the anti-ATP extract; they didn't wilt if pure ATP was added to the extract. Now the intriguing part is that the identical ATP is the source of human energy—it makes your muscles flex. Could trees have muscles that, prodded by ATP, flex to lift sap? Maybe.

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The March of Science . . . continued

won. John Wimpenny, 39-year-old engineer for the British aircraft firm of de Havilland, pumped the pedals that spun



the prop on the gliderlike machine (shown in photos on p. 106, PS, May). He flew 2,979 feet at 19 m.p.h.

Fat by nature

Those people who complain, "I'm fat even though I don't eat a thing!" may be right—sometimes. At least 25 percent of overweight persons are kept that way by body chemistry, says Prof. Edgar S. Gordon of the University of Wisconsin.

Lots of laughs in the Air Force

An Air Force report on what was apparently a serious scientific study states, "Witticisms can be used by those who are committed to their use as an interactional technique to reduce the tensions of a group under stress . . ." The amazing discovery that a belly laugh feels good when you're in trouble has encouraged further research. Next comes a study of "the content of these witticisms to determine the exact mechanisms used . . ." After that—a government-issue joke book? ■ ■



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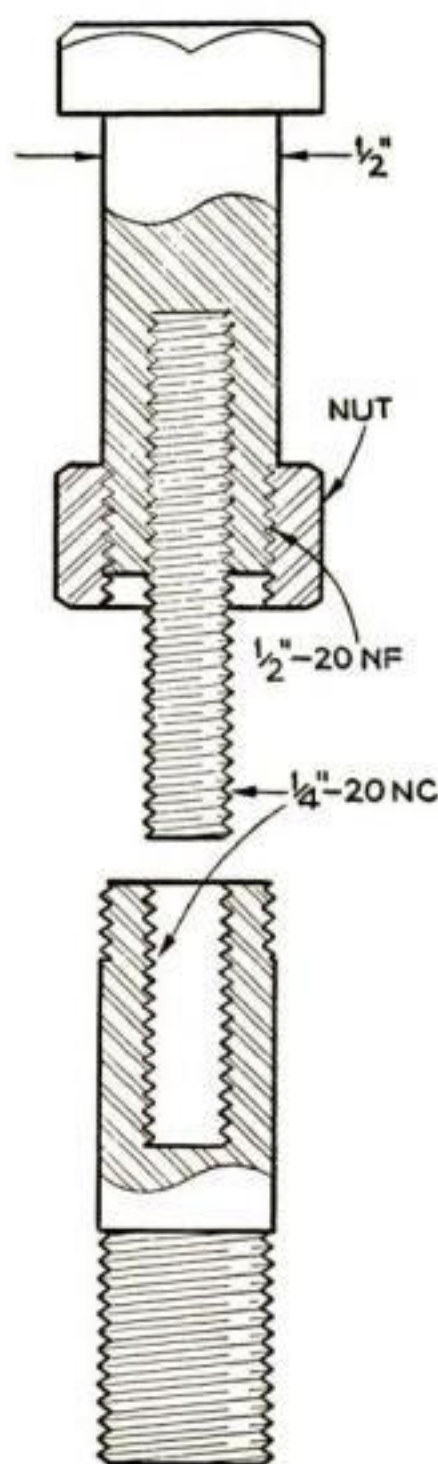
SHOP TALK

By Sheldon M. Gallagher



That nut-and-bolt mystery—here's the answer

Remember the bolt we showed you last month with a nut threaded on the middle? The trick is based on the fact that $\frac{1}{4}$ " National Coarse threads and $\frac{1}{2}$ " National Fine threads are both 20 to the inch. The bolt's shank is made in two pieces pinned together with a $\frac{1}{4}$ "-20 NC stud, as shown in the drawing. The outer threads are $\frac{1}{2}$ "-20 NF and are turned on a lathe so they run continuously across both shank halves. The halves are taken apart and a standard $\frac{1}{2}$ "-20 NF nut screwed onto the head half. Since both parts have the same threads per inch, the other half can then be screwed onto the stud and into the nut at the same time. The nut hides the joint and spins freely on the outer threads. Neat, huh? Our thanks to Ralph Culp of Springfield, Mo., for a fine teaser.



Coming soon: A battery drill for 110 volts, too

Our friends from Porter-Cable stopped by to chat recently and dropped a quiet bombshell in the form of a prediction: The new Porter-Cable battery-powered drill [\[see June, p. 151\]](#) may soon be available with an accessory for use on regular house current. If the idea becomes feasible, it should end the biggest obstacle to battery power—namely, that you still need a conventional drill for hard, everyday shop use. With the P-C system, you'd buy only one drill, using it indoors on conventional power, outdoors on battery pack. The result: a tool that gives you both unlimited power and portability in a single package. We've tried the drill, and it's a honey—has enough torque to wrench the tool right out of your hand if you bear down hard. For battery power, brother, that's saying a mouthful.

New reversible drills: some surprising uses

When Portable Electric Tools announced a coming line of reversible $\frac{1}{4}$ " and $\frac{3}{8}$ " electric drills, the first in home-shop size, we got to wondering what some of their uses might be. We asked PET to pass along a few, and they add up to a pretty good case for reversible power. For example:

1. You can prolong the life of accessories such as wire brushes, buffers, and grinders that tend to wear fast and take a "set" when used in one direction only. By alternately running the drill for-

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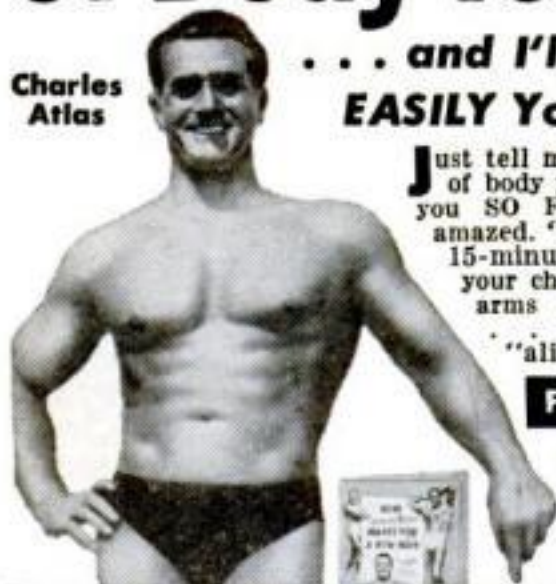
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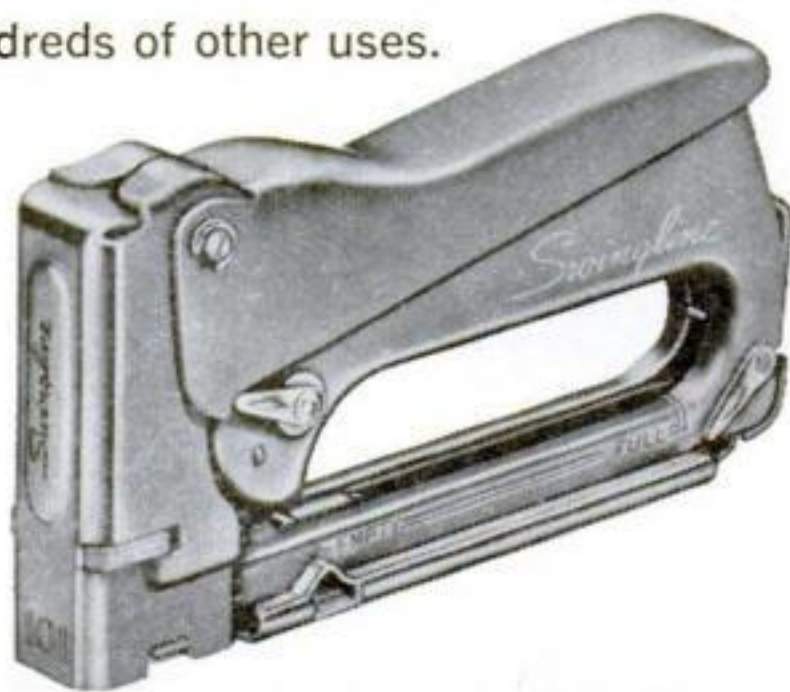
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SHOP TALK

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Detroit report

That Japanese VW

Last November "Detroit Report" said a Japanese auto maker was planning to put a Volkswagen-like car, on Karmann-Ghia lines, in U.S. salesrooms. Inquiries poured in. When? Where? We had to reply in the words of a famous actress, "That's all there is, there isn't any more." That was all we knew.

Now we can add a footnote. Not one, but two, Japanese manufacturers, Honda Giken and Toyo Kogyo, will bring out midget sedans later this year for eventual export to the U.S. Both cars will be powered by small, water- (not air-) cooled, four-cylinder engines. Honda is a motorcycle maker, and Toyo's chief product is a motorized tricycle.

Price of the new cars? Styling? Well, again we have to hedge. For now, *that's* all there is, there isn't any more.

Those aluminum radiators

Some of those Chevy IIs that you pass on the highway incorporate a secret that may hold a promise of better hot-weather engine performance in tomorrow's automobiles. The secret: aluminum radiators. Aluminum, as every housewife knows, is a superior heat-absorber and heat-dissipator. Cooking utensils prove it.

A couple of thousand Chevy IIs with aluminum radiators are now being field-tested. The Chevy Corvette pioneered this radiator, and now GM wants to know how it works on garden-variety cars. If it proves out, it could become a standard fixture on all cars. It could be an answer to overheating.

There are problems, though. The wrong kind of antifreeze can corrode an aluminum radiator and, when damaged, it is harder to repair than the copper-core type.

Cure for tired springs

Few motorists realize that front springs take a "set" in time, and sag.

A combination spring and shock absorber that will take the sag out of front ends when springs lose their springiness has just been announced by the Monroe Auto Equipment Co. Monroe makes the same thing for the rear springs [PS, May '62, p. 130]. But its Load-Leveler for the front does a lot more.

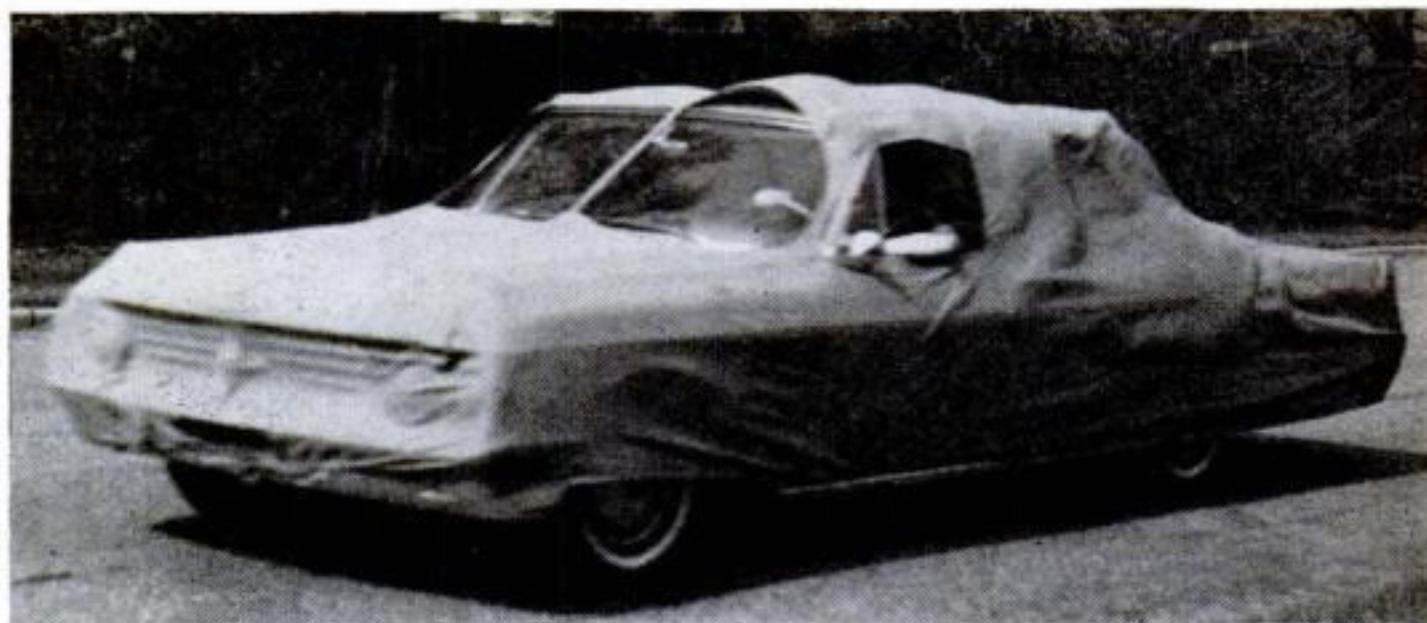
It provides additional stability in going around turns and a more comfortable ride on rough roads. It eliminates side-sway in crosswinds and stops the "whip" experienced by light cars in passing trucks at highway speeds. It also reduces tire wear by helping maintain the front-end alignment.

Turbocharger troubles

The Olds F-85 supercharger was tardy in appearance because the gas kept freezing. Solution: They've added a carburetor heater.

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*What's coming
in next year's
cars? For a look
ahead, see
pages 46-49.*



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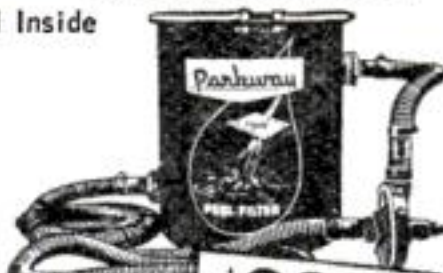
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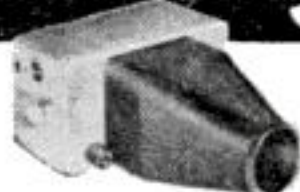
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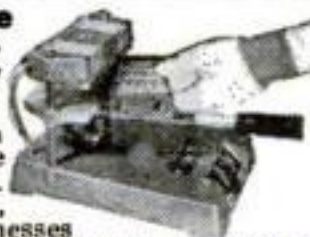
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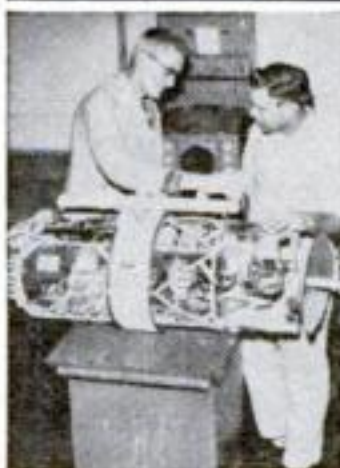
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Inflammation

☐ Hernia
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1887 "A claim for the first thought of the germ theory of disease is made for a Dr. Goiffon, who died at Lyons 150 years ago. He believed, in 1721, that diseases like the plague could be caused only by minute insects or worms, too small to be seen."



"Describing Queen Nga Nkabe of the Ba-Buma people of the Congo, the Rev. T. J. Comber said she was, 'tall, brawny, and dignified, but did not seem to think it beneath her to cut us a bunch of plantains. She was pleased with a present of cloths, a big bell, a soldier's great-coat, and some brass, but her great desire was to possess a double-barreled gun. Her husband sits by and lets her rule.'"

1912 "A professor in the University of Tokyo remarked to a group of American visitors, 'Yes, the campus is beautiful—but it is not large enough for baseball.' The latter bids fair to become the national game of Japan as it is of the United States, young Nippon taking to it as readily as does young America."

"We uniformly buy our shoes a size to a size and a half too small for us. Why we have the insane delusion that our feet should be small no one can explain. Orators have praised small feet and poets have sung to them, and really for want of proper use. From being encased in unyielding leather boxes from early childhood, our feet are much smaller in proportion to our size than they should be. By reason of the absurd pointed-toe shoes, which men and women both wear, man is becoming practically a unidactylous animal."

"New York City is now an Italian city as large as Rome. The Austro-Hungarian

population of New York has more than doubled, now is 267,000. But greatest of all is the Russian increase from 180,000 in 1890 to 484,000 in 1910. A citizen of New York on being asked whether there was a foreign quarter in the city replied that there was a foreign three-quarters, and that is not far from correct."

1937 "Invented by Prof. Albert Einstein, famous mathematician, and Dr. Gustav Bucky of New York University, a new camera automatically adjusts itself to the correct exposure for existing lighting conditions. Light entering an auxiliary lens strikes a photo-electric cell and causes it to move a screen filter of varying transparency to control the amount of illumination striking the film."

"A race between a man and a horse ended with the honors on the side of the human contestant when Jesse Owens, the Negro track star whose performance won him fame at last summer's Olympic Games, recently demonstrated his sensational fleetness of foot at Tropical Park in Cuba. Proving a 40-yard handicap allotted to him was more than he needed, he sprinted 100 yards in less than 10 seconds and finished a full 20 yards ahead of the pride of Havana's stables."



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PONDEROSA
PINE

LOGEPOLE
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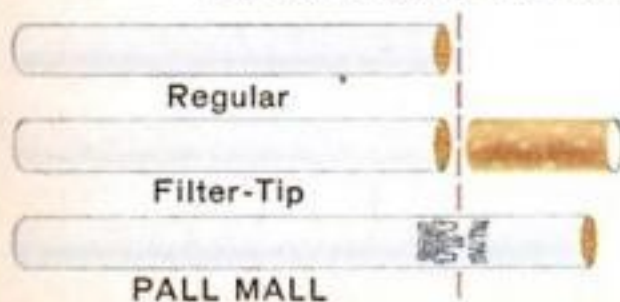


Pall Mall's natural mildness is so good to your taste!

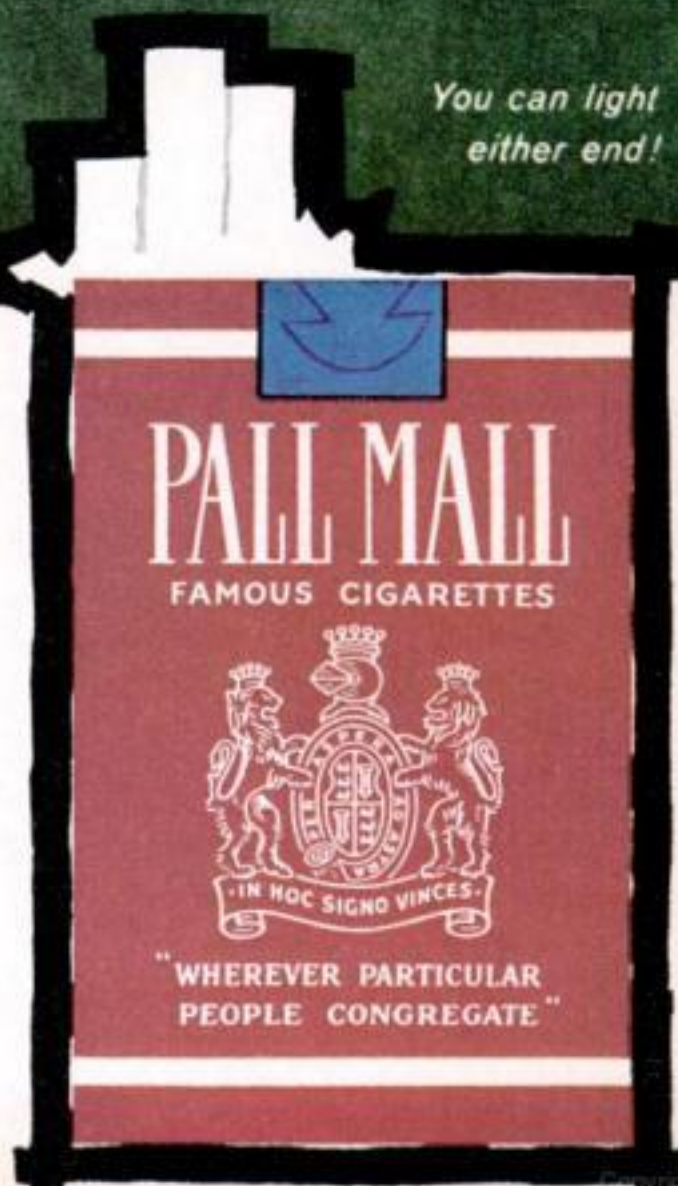
*You can light
either end!*

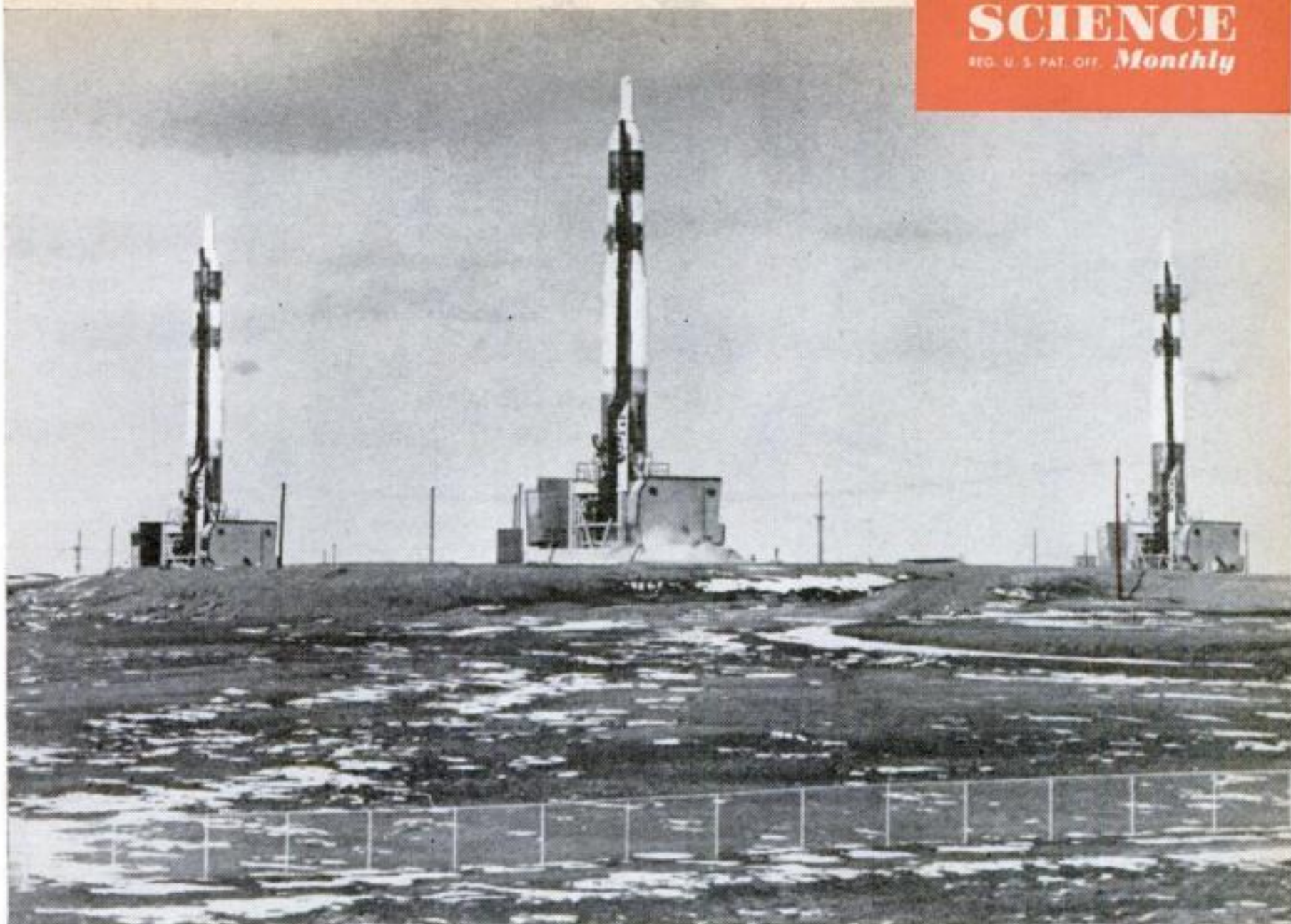
***So smooth, so satisfying, so downright
smokeable!*** For flavor and enjoyment you just
can't beat Pall Mall's natural mildness. It's so good
to your taste. Never too strong. Never too weak. Al-
ways just right! Enjoy satisfying flavor... so friendly
to your taste. ***Outstanding... and they are Mild!***

COMPARE ALL THREE!



Smoke "traveled" through
fine tobacco tastes best.
Pall Mall's famous length
travels and gentles the smoke
naturally . . . over, under,
around and through the finest
tobaccos money can buy.
Makes it mild but does not fil-
ter out that satisfying flavor!





Three Titans, first of invulnerably "hardened" ICBMs, stand ready to go from Colorado ridge.

Underground with the **TERRIBLE TITAN**

Those aren't prairie-dog holes Uncle Sam has been digging on the Great Plains. Here's a PS editor's report on what goes on in missile complexes from Colorado to Montana

By Martin Mann

"THIS is the year of the big pay-off in missiles," says Air Force Major General Thomas Gerrity, who makes them.

At the beginning of 1962, the U.S. had 54 Atlases, eight-story-tall rockets that can circle the globe to wipe out cities, but are themselves vulnerable to attack. In April, the first Titans—bigger and deadlier—went into underground silos, impregnable to anything but a direct hit. Later this year the smaller and cheaper

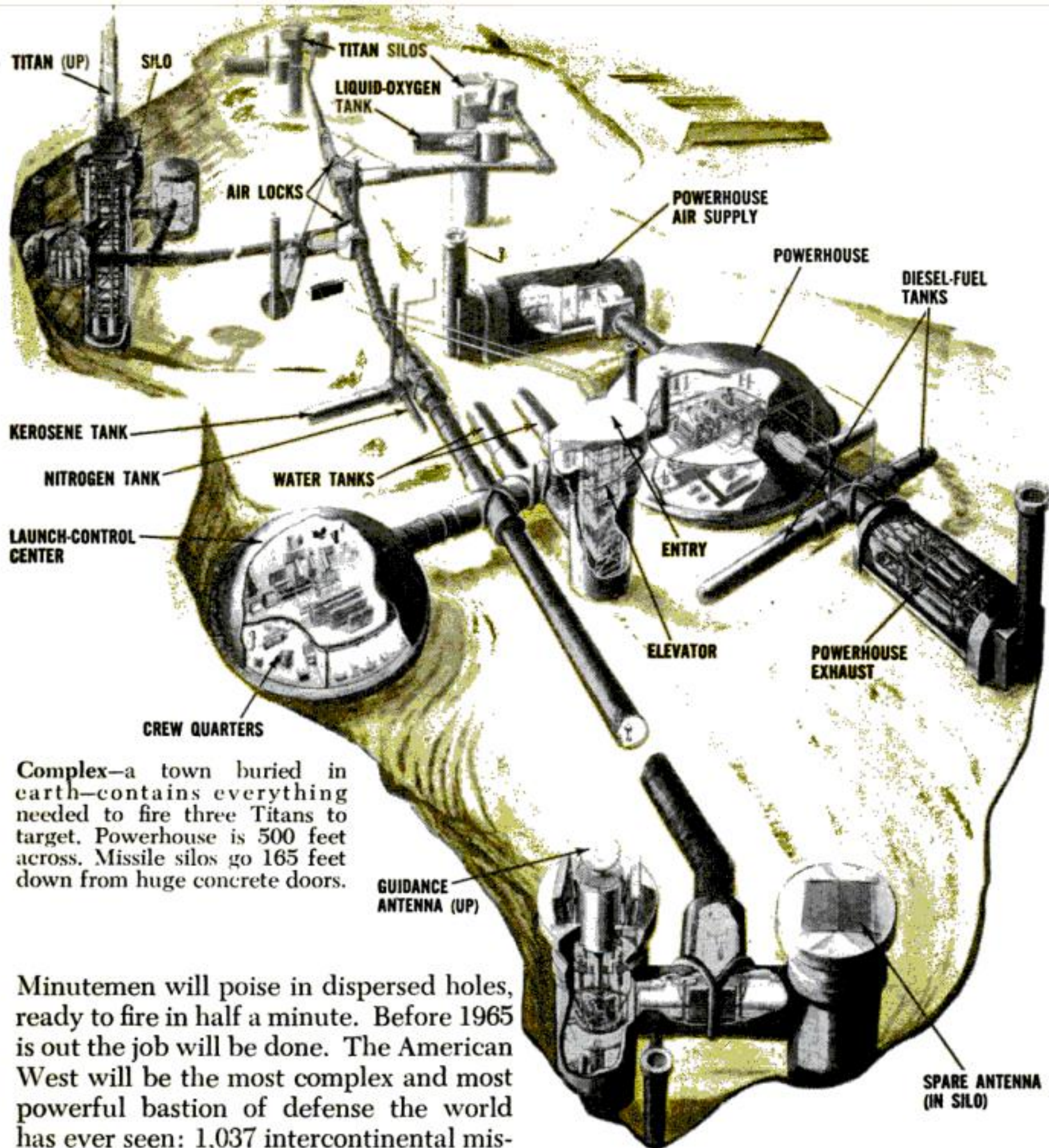


★ SAC HEADQUARTERS ● TITAN ○ ATLAS × MINUTEMAN

Formidable force of H-bomb-armed long-range missiles is concentrated almost entirely in West, far away from our biggest population centers.

CONTINUED

35



Complex—a town buried in earth—contains everything needed to fire three Titans to target. Powerhouse is 500 feet across. Missile silos go 165 feet down from huge concrete doors.

Minutemen will poise in dispersed holes, ready to fire in half a minute. Before 1965 is out the job will be done. The American West will be the most complex and most powerful bastion of defense the world has ever seen: 1,037 intercontinental missiles that no sneak attack can disable, that can almost instantly strike back to destroy an aggressor.

That's what they say. I have seen some of it, and the claim appears reasonable.

DRIVING along Colorado Route 30 about 25 miles southeast of Denver you see the Rockies jutting up on your right, a long, low ridge carpeted in alfalfa off to the left. The ridge sprouts what seem to be three tall pine trees. They aren't. They are Titans, lifted from their silos to firing position. Each stands 10 stories high and can rocket across continents to blast a bull's-eye with the force of 12 million tons of TNT.

When the Titans are down—as they usually are—nothing shows from the highway. Only a dead-pan sign, "Site A-1," hints that buried deep beneath the ridge are monstrous weapons, a fantastic maze of tunnels, elaborate electronic controls, huge tanks of kerosene and liquid oxygen, generators big enough for a town of 10,000, and 11 coolly alert men.

The sole building on the ridge is a green-painted plywood shack. It encloses an elevator (for freight or visiting firemen like me) and a stairway (for the crew). Six stories down and you are in the core of the weird space-age fortress.



Construction of U.S. ICBM bases (above is one Titan complex) dwarfs that of Pyramids.

Total of 37,550,000 cubic yards of dirt will be dug, 2,647,000 cubic yards of concrete poured.

It looks vaguely like a ship. The tunnels are corrugated steel cylinders half choked with pipes and cables. Everything is bright yellow or green; you can still smell fresh paint. You notice the fluorescent lamps. They hang on springs. And the iron pipes suddenly change back and forth to rubber hose every few yards. This is your first introduction to

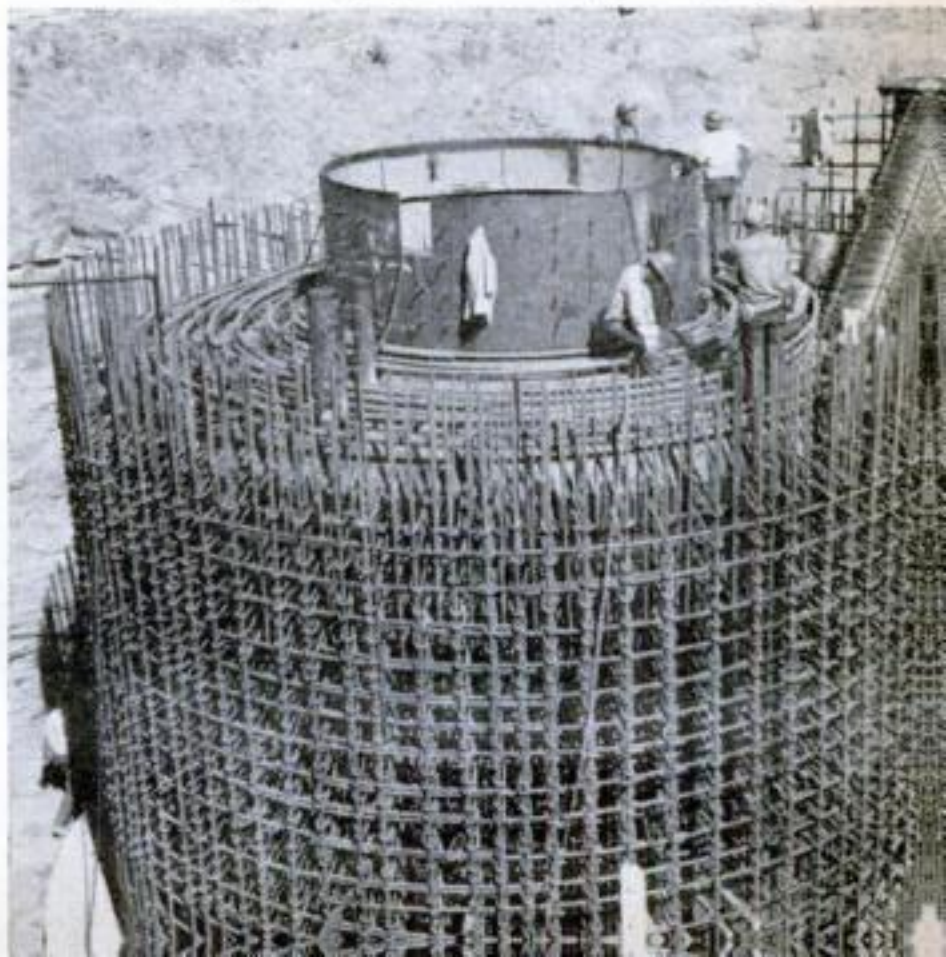
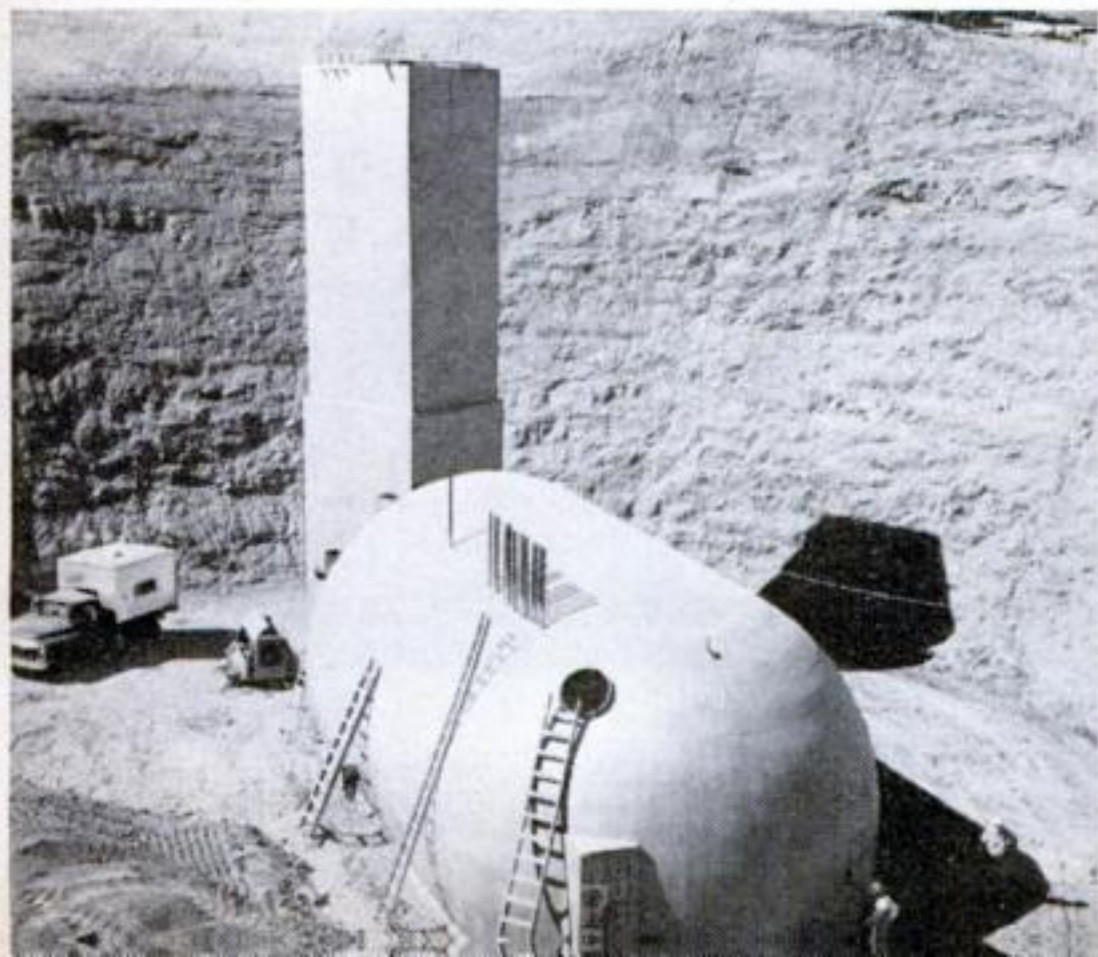
blast-resistant construction. A near miss will shake things up, but not wreck them.

The Titan complex is laid out like a small town. Main Street is one long tunnel—a quarter of a mile—running from the missile silos at one end to the guidance antennas at the other end. (The antennas, which transmit steering signals to the rocketing missiles, stay under-

CONTINUED

Minuteman sites are small and simple—but there will be a lot of them. Tanklike structure (shown before dirt was filled in) is the two-man control center; "chimney" is elevator shaft.

Why missile silos can't be knocked out: Thick walls are heavily reinforced with steel. For Minuteman silo (below), concrete is mixed in forms by squirting grout through dry gravel.





Tunnels totaling half a mile in length interconnect sections of underground Titan fortress. This photo shows some of the elaborate precautions that enable complex to shrug off H-bomb attack: Notice flexible sections in piping at lower right and looping down from upper right and left. Fluorescent lights hang from springs. Covered trays at left side of tunnel carry cables for power and control.



Titan is steered during first 10 or 15 minutes of flight by radar signals controlled from this console. Rectangular screen (center) shows TV picture of missile as seen from ground.

Visitors can't miss the point of billboard at SAC headquarters. This is a spit-and-polish outfit—pipe the guard's get-up: beret, scarf, fourragère, fancy belt, horn-handled .38.



ground until button-pushing time; then one rises to the surface—the other is a spare.) Short side tunnels branch off Main Street to the Launch Control Center and to the powerhouse.

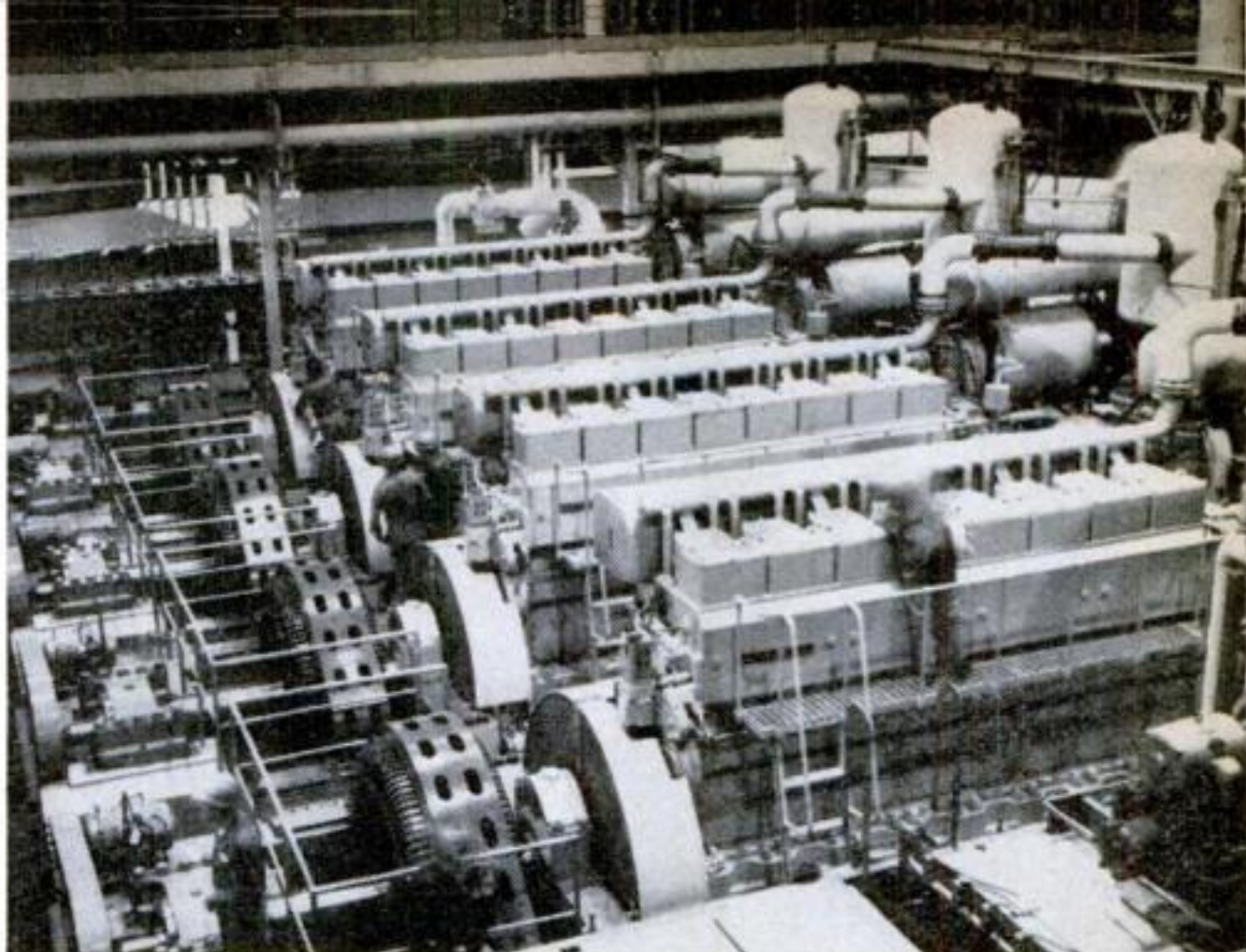
The powerhouse is huge: three open levels under a domed ceiling, four roaring diesel generators. A movie theater would be lost in this concrete cavern.

You begin to see where 60-odd million tax dollars went: enough concrete for the basements of 1,400 houses, enough steel for 9,700 cars, enough wiring for 1,600 houses, enough electronic parts for 66,000 radios, enough air conditioning for 250 houses, enough diesel fuel to take a freight train from Denver to New York and back—23 times.

THE missile silos are oddly disappointing. The approach is dramatic enough: an air lock with blastproof armor-plate doors that are electrically interconnected so you can't open one unless the other is closed. The inner door leads to a narrow steel-mesh landing at about the 11th-story level of a 165-foot-deep hole. Only you can't see much. The silo is completely lined with heavy steel cribbing. The crib, which supports the missile and its elevator, stands free of the silo wall on springs (for blast protection).

But when you come to the Launch Control Center, there's no disappoint-

Huge powerhouse supplies enough electricity for a town of 10,000. It has four 1,000-kilowatt diesel generators: two on the line, one running as standby, one spare. Air inside is kept at slightly more than atmospheric pressure—inflammable fumes of kerosene or oxygen can't possibly leak in from missile storage tanks. Crew now wear missilemen's working uniform: white coveralls, scarf, hard hat.



ment. It is straight out of Buck Rogers.

The lower floor is Air Force-style living quarters—utilitarian but comfortable. Eleven-man crews spend 24-hour tours here—16 hours on duty, 8 hours sack time. There are a galley, double-decker bunks, a day room (fishing-lodge chairs, a TV).

Upstairs—though still 55 feet below ground—is Buck Rogers, too. The commander of the Titan complex sits at a desk in an office, watching his launch crew and their mysterious black boxes through a glass wall.

These men are lean and serious, resplendent in blinding white coveralls with insignia on collars or sleeves and blue neckerchiefs. The captain and lieutenant wear .38 police specials on their hips.

From airplane-type seats—with safety belts on (blast protection again)—they keep tabs on the missiles' intricate innards. They load kerosene and liquid oxygen (lox), raise or lower the elevators, send the birds off, and steer them to target. There are three TV screens: one shows the ground above, one covers the entryway, one follows the missile.

The Button is on the captain's console, secure behind a lead seal. It won't work until unlocked by an electrical signal from another Titan complex. And even then, the captain and the lieutenant must operate it together. There will be no accidents, no mistakes, no let's-stop-fooling-

around-and-end-the-cold-war-ourselves.

SITE A-1 of the 724th Strategic Missile Squadron is the first U.S. "fully hardened" ICBM base. It is hard. You can see the steel girders hinged to swing without breaking, the spring-mounted floors and machines, the stairways that float free of floors, the massive concrete walls, the deep underground setting. It could be destroyed by a "direct" (that means close) hit from a big bomb. But, the Air Force maintains, not even the H-bomb equivalent of 50,000,000 tons of TNT could knock out more than one complex with a single blast.

Yet this fantastic fortress is already obsolete. It is too slow on the trigger. Its type I Titan missiles must be loaded with lox and then raised out of their silos before they can be fired. Some officers claim this can be done in 15 minutes.

Maybe.

It takes 8 to 15 minutes just to pump the lox in. The elevator speed is supposed to be secret, but the missiles were lowered into their silos as I stood there. By my watch, it took at least seven minutes. They can't go up any faster than they go down.

At the very best, our warning of missile attack will be only 15 minutes. Retaliation that takes longer than that to get off

[Continued on page 174]

A large, stylized word 'PAIN' in a bold, red, serif font. The letters have a textured, slightly distressed appearance. At the bottom of the image, there are several cartoon hands reaching up towards the letters, suggesting a struggle or a desire to hold onto the word. The background is white.



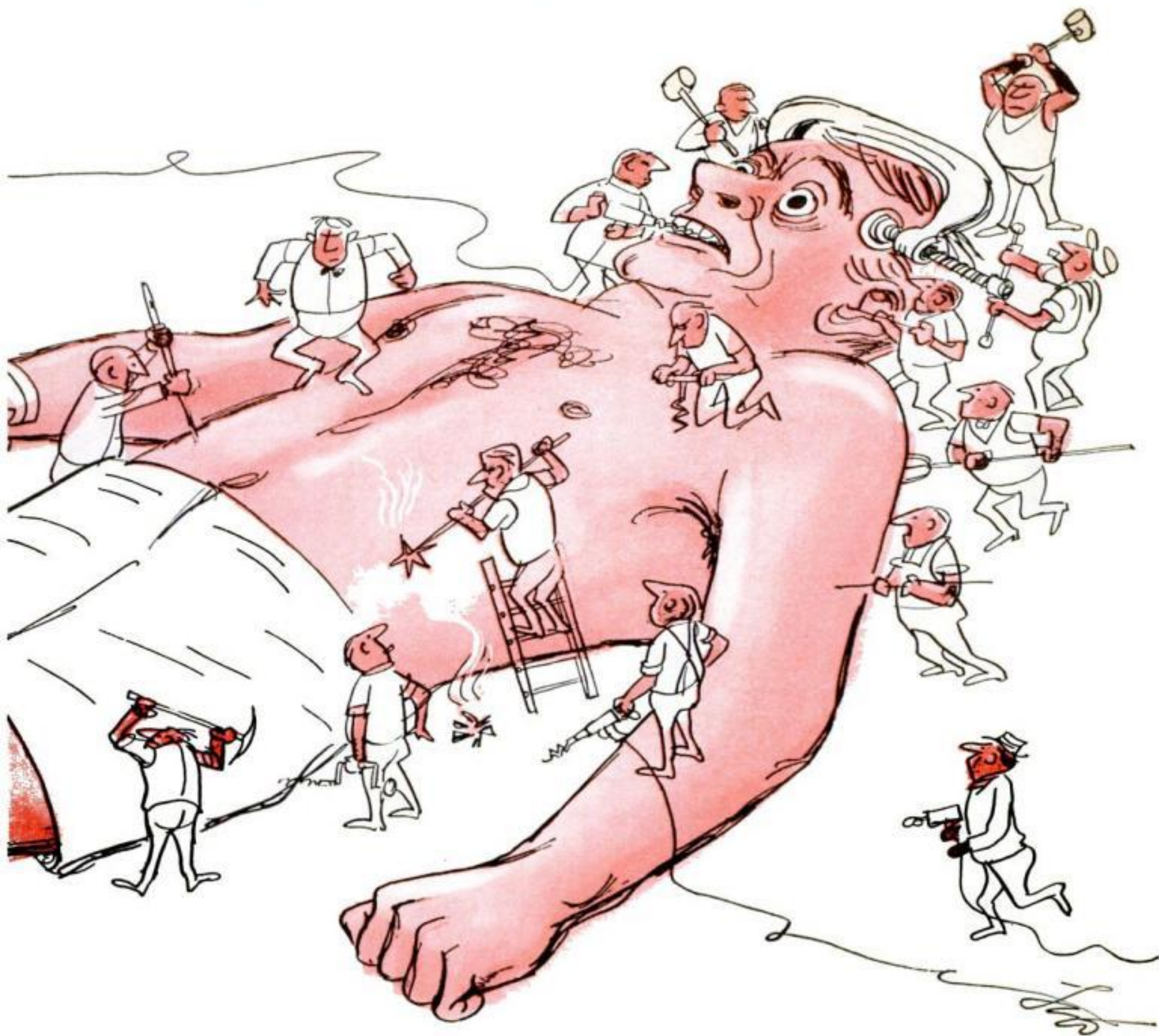
● What causes it? ● What can you do about it?

PAIN is one of the most common of all human experiences. One bit of evidence: Any single day in the United States, people gobble 21 tons of aspirin—not to mention other pain relievers.

A psychiatrist recently observed, "It is easier to be philosophical about death than about pain. Death is the transition from living chemistry to just chemistry—but you can't make wisecracks about severe pain."

Not that scientists try to. With much still to learn, they've been busy turning up a good deal of information recently about the phenomenon—for example, what's involved in pain, how and why people react differently to it, how some once-puzzling forms come about. And they've been uncovering some striking new ways to relieve pain, too.

BY
LAWRENCE
GALTON



● Why is it necessary? ● How much can you stand?

What is pain?

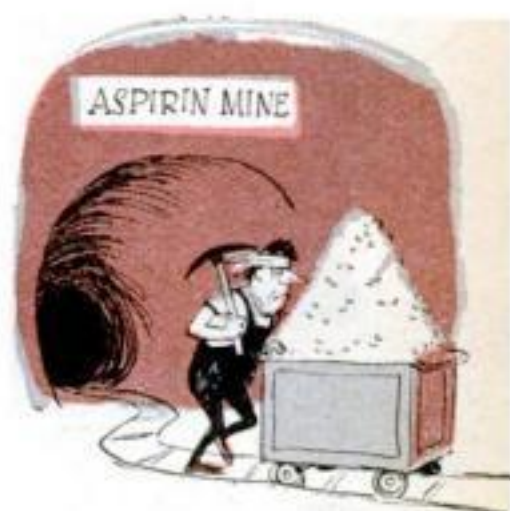
Dictionaries are no help. One calls it "bodily or mental suffering or distress." Even a medical dictionary does no better: "Distress or suffering."

A distinguished physiologist once announced pain to be "the physical adjunct of an imperative protective reflex." Which led one observer to remark that whatever that meant, it was hardly any help to a man with a toothache.

What's involved in it?

That's clear enough: two elements—sensation and the reaction to the sensation.

Say your skin is punctured or burned. Nerve endings around the site generate a pain signal. It travels to the



We gobble an astonishing 21 tons of aspirin every day.

How much pain should you put up with? No more than you

spine and up the spine and into the brain. You perceive the pain. Then you react to it—and that's another matter.

Do people react differently?

Decidedly. Eskimos, for example, have been known to hack off a gangrenous foot to save a leg—and do it without wincing—but it's not uncommon for gray-flanneled Madison Avenue executives to shudder at the first sound of a dentist's drill digging into a heavily novocained tooth.

Is it because an Eskimo feels less pain? New York Hospital researchers have proved otherwise. Using a lens to focus heat from an electric bulb onto a blackened area of skin, they tested white people, Eskimos, and others. All said "ouch" or its equivalent when skin temperature hit 113 degrees.

What pain means to you, your past encounters with and attitude toward it, your mood at the moment, whether you're anxious or not about it—all these are factors that influence your reaction to pain.

During the excitement of a game, for instance, an athlete may pay little or no attention to an injury, even a severe one—but he will afterward.

At World War II's bloody Anzio beachhead, a check showed that only 25 percent of seriously wounded soldiers said they had enough pain to want anything done about it. On the other hand, 80 percent of civilians with far smaller wounds after surgery complain about pain.

Doesn't pain sensitivity vary at all?

To some extent. Recently, Dr. John S. Lundy of the Veterans' Administration Research Hospital in Chicago has observed that redheads tend to be more sensitive, blonds less, brunets least of all.

After a study of 403 patients getting their teeth drilled, an Australian investigator thinks that the bluer peoples' eyes are, the less pain sensitivity—and as color goes from blue-gray to hazel to dark brown, the greater the sensitivity.

According to a recent Canadian study, pain sensitivity seems to decline with age. In tests on 200 people divided into two age groups—20 to 30 and 65 to 97—it generally took a greater stimulus to provoke pain sensation in the oldsters.

Do some people feel no pain?

Indian fakirs snuggle down on beds of nails—seemingly in comfort. That's been explained on the basis of hysteria—a kind of emotional frenzy that may act like an anesthetic.



"Hard-boiled" businessmen may shudder at the first sound of a dentist's drill. Eskimos are tougher.



Is it really true that redheads are more sensitive to pain than blondes? And brunettes least of all?

need to—and chances are you needn't put up with any

One recent medical study shows that many mentally disturbed people are nonresponsive to pain. One-third of a group of psychotic patients with acute perforated peptic ulcers, acute appendicitis, and bone fractures—all very painful conditions—felt no distress.

But there are also people born indifferent to pain—congenitally immune. Among a series reported by one neurologist not long ago was a seven-year-old girl who often deliberately burned herself on a stove because “it felt good.” A pain-free lawyer who crushed a finger in an accident simply bit it off.

The “human pincushion,” a well-known vaudeville performer of some years ago, regularly had as many as 60 pins stuck into him as part of his act, with no apparent discomfort.

Does some special substance in the body cause pain?

Recently University of California investigators injured some areas of skin in volunteers—and succeeded in extracting a special chemical, neurokinin, from the injured sites. When they injected it into normal skin sites, it produced pain and inflammation. Subsequently, looking for it, the California workers managed to find large amounts of neurokinin in painful regions of the scalp during severe migraine headaches.

Interestingly enough, while neurokinin produces pain, it also seems to make a contribution to repair of the injury—by increasing blood flow to the area so debris can be carried away and defenses against infection can be mustered.

Does pain serve a useful purpose?

Yes, it's an alarm device—a warning that something is wrong. And it often lets you remove yourself from danger.

Even as pain impulses shoot out, say from a fingertip you've seared on a hot stove, and move into the spinal cord and up to the brain, some of the impulses take another path. They get routed over a short nerve to a motor center in the spinal cord, and from here a message goes out so that you jerk your finger away from the stove even before your brain has a chance to ponder what's happened.

Pain serves another purpose, too. Your ability to describe its character and location often can help a doctor figure out what's wrong—appendicitis, for example—and what to do about it.

But once pain has done its useful work, it can exact a

[Continued on page 176]

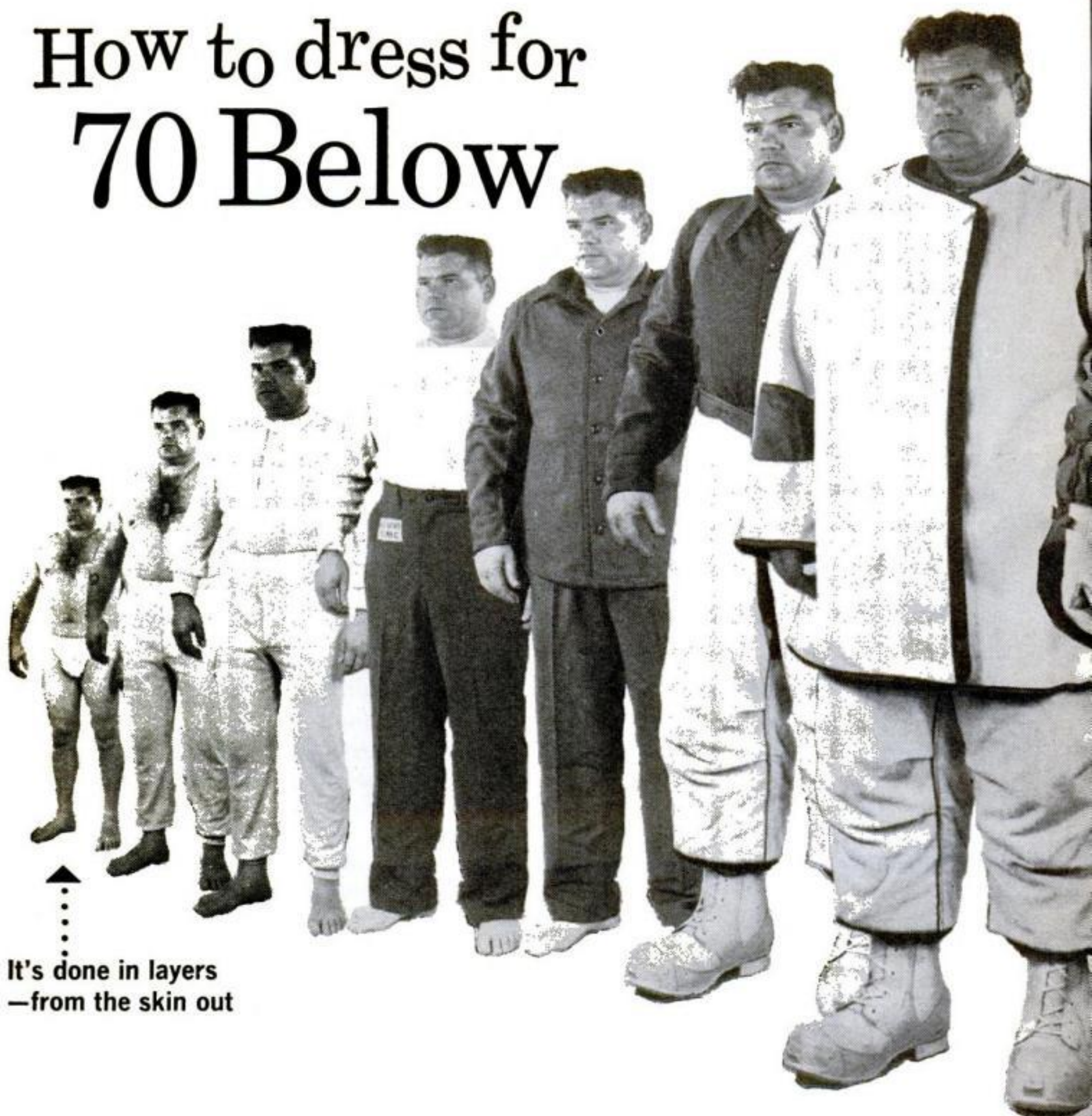


The “human pincushion”—a well-known vaudeville performer—had as many as 60 pins stuck into him, with no apparent discomfort.



Ouch! You jerk your finger away from a hot stove before your brain has a chance to ponder what's happened.

How to dress for 70 Below



It's done in layers
—from the skin out

TRAINING men to fight in the Arctic, the Army has to teach them first how to dress so they won't freeze to death or become too numb to handle weapons.

Temperature shifts rapidly above the Arctic Circle, so the GIs clothe themselves in layers: adding more as it drops, shucking some as it rises, say, to a relatively mild -40 . For extremes of -60 to -70 degrees, the well-dressed soldier looks like the man at far right in the photo: a bulky teddy bear in six layers, some $31\frac{1}{2}$ pounds of cotton, wool, mohair, and fur.

Here's how he puts them on (from left to right): cotton-wool-knit longjohns and un-

dershirt; wool trousers and shirt; mohair trouser lining and suspenders; upper mohair insulating liner; cold-dry uniform shell with pile cap and mittens; detachable fur ruff; and on top of all a white water-repellent field parka for camouflage in snow.

On his feet he wears heavy woolen socks and Mickey Mouse boots built like a vacuum bottle with inner and outer sealed layers of rubber to form a vapor barrier and insulated with felt.

But the Quartermaster Corps keeps on experimenting with new materials. Now it's considering an all-in-one suit with chemical or electrical heating elements.



Under six layers, ready
for bitterest cold



Surprises are scheduled for the showrooms this fall

What's Coming in the 1963 Cars

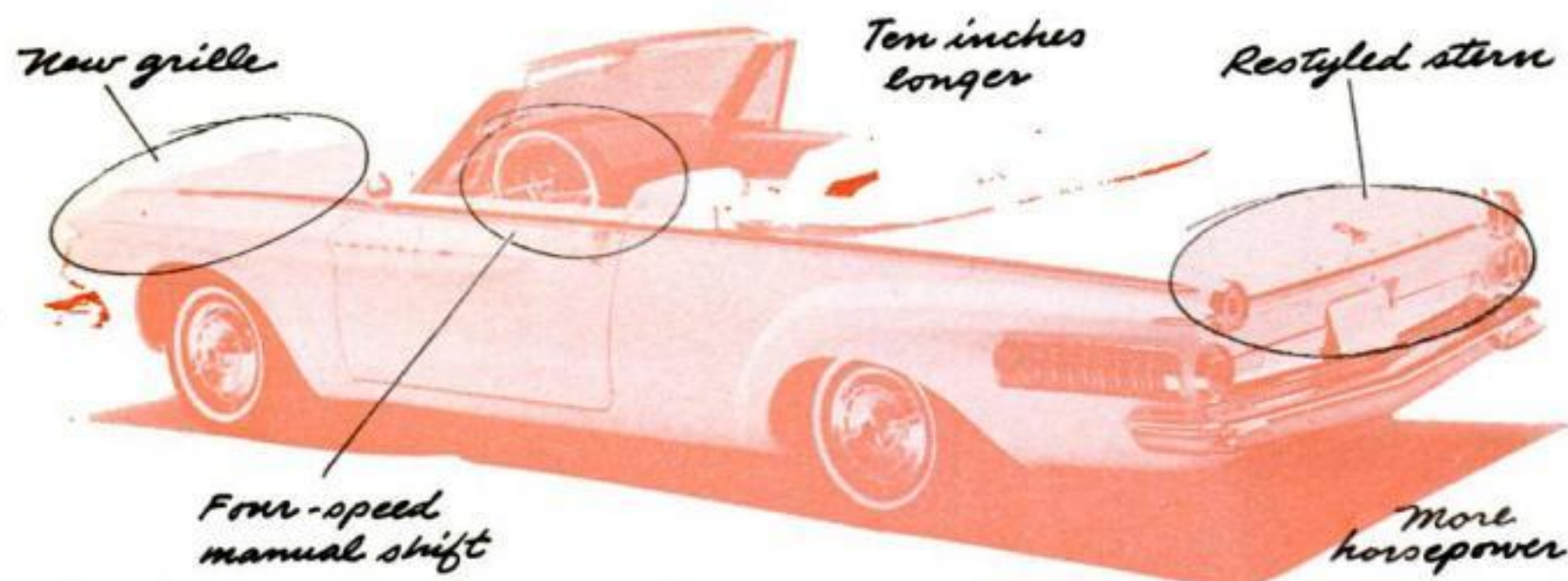
By Devon Francis

IN GENERAL MOTORS' Styling Center, a few miles northeast of Detroit, a unique system permits changing the center's door locks whenever an executive suspects that unauthorized personnel are getting too snoopy. In the door-handle assembly is a series of recessed buttons, each with a num-

ber. Entry to the studios is made by turning the knob and pressing the buttons in proper sequence. The sequence combination can be changed daily, or a dozen times daily, as occasion demands.

Before the first frosts of autumn whiten the landscape, the 1963 crop of GM automobiles that have been behind those locked doors, as well as the cars of other manufacturers, will be on display

The Dodge: One of the biggest changes in its history



Chrysler Corp. cars will make the biggest styling news. They have to. The corporation has had a near-disaster in the salesroom since the appearance of the 1962 cars last September. The company's grim dilemma: change the appearance of its cars, or risk collapse as an automobile manufacturer. Elwood P. Engel, chief stylist of Ford Motor's "advance studios," was hired away by Chrysler and given a blank check.

The change in the looks of Chrysler Corp. cars for '63 has been described as the biggest tear-up in plans in Detroit's history. That's an exaggeration. It's a major tear-up, but the basic body shells will remain the same. Engel, hard at work since last fall,

has not had the time to achieve what he wants to. His breath-taking alterations are reserved for the 1964 models.

Engel's sterns will look nothing like those of 1962. Gone will be the foreshortened look, embodied in bobtails and the European-style framing of rear wheels. Grilles, of course, will be changed in all the company's cars.

The regular Dodge will return to its old size of about 212 inches, compared with the present length of 202. In its role as the company's experimental car, Dodge also will build a "performance image," with engines of piston displacements running all the way from 170 to 413 cubic inches. The

in thousands of showrooms throughout the country. Meantime, GM, and the Detroit community at large, is guarding its new products with all the irascibility of a bear protecting her cubs.

Big things, as usual, are in store. Styling changes, some of them spectacular, will appear. The shrouds will be yanked off at least one new brand name. Some models will be orphaned—nobody has loved them enough.

Choices of models will proliferate. The motorist could choose among 360 in 1962. For 1963, that number will be close to 400.

As a piece of sales catnip, economy will be dead. Compacts will be fancier. The use of expensive vinyl tops as pure decorative fluff on steel-ceilinged cars will spread. By the close of this month, when production lines on '62 cars will

be shut down, 700,000 cars will have been produced with that new symbol of driver arrogance, the bucket seat. They appear in more than 75 different car styles.

A million bucket-seated cars will be produced during the '63 model year. The different types of car styles carrying them may go as high as 90.

More and snootier two-door hardtops will be offered.

Existing high-horsepower engines for high-cost automobiles will drift down as options among lower-cost cars.

All cars will be equipped with positive crankcase ventilation—the system for returning crankcase fumes to the cylinders for reburning.

By companies and brands, here are some of the things that are coming in the 1963 cars.

company set the stage for this with high-power options during the '62 model year.

The Dodge Dart will be shortened by five inches to distinguish it from the big Dodge, the Polara. The compact Dodge Lancer—if, indeed, it retains the brand name at all—will be lengthened for two reasons: to make it look different from the Plymouth Valiant and, more importantly, to put it in the class of Ford's Fairlane.

Except for a reworked rear end and new grille, the Plymouth will change little.

After bucking the trend since last September, Chrysler will offer, at the start of or during the course of the model year,

floor-mounted, four-speed manual transmissions in the Plymouth, Dodge, and Chrysler lines.

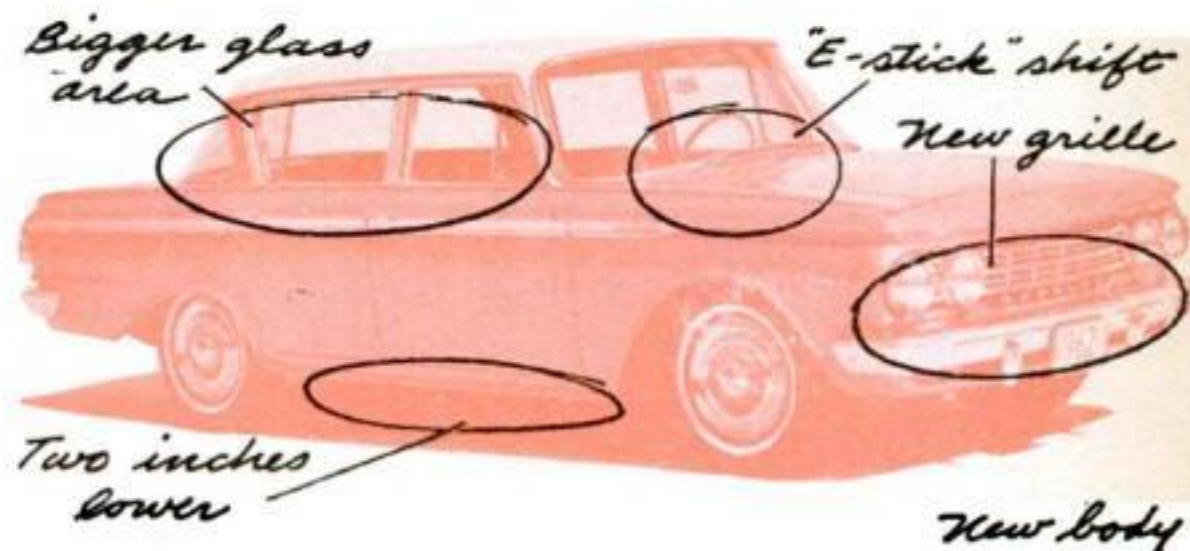
As has been announced, Chrysler will build some 75 gas-turbine cars (at a price high enough to scare off all but the well-heeled customer) for a carefully selected clientele. This is in no wise to be interpreted as a move toward abandonment of the piston engine. It is only a gesture toward bolstering the company's reputation for advanced engineering.

Later in the year the company will introduce a prestige sports car in the class of the Chevy Corvette and Studebaker Avanti.

The Rambler: It will hardly be recognizable

Ramblers, excluding the Rambler American, will hardly be recognizable. In silhouette, they will have the lines of Chevy's Corvair, despite a difference of four inches in height. The big surprise will be a lowered height—down a full two inches from the present 57.5. The glass area will be bigger. All this will be accomplished at an astonishing economy in actual changes over '61.

The rear body sheet metal, known to the



industry as the quarter panels, will be new, as will the front fenders. The top-of-the-

Look for more substitutions of alternators for generators, new

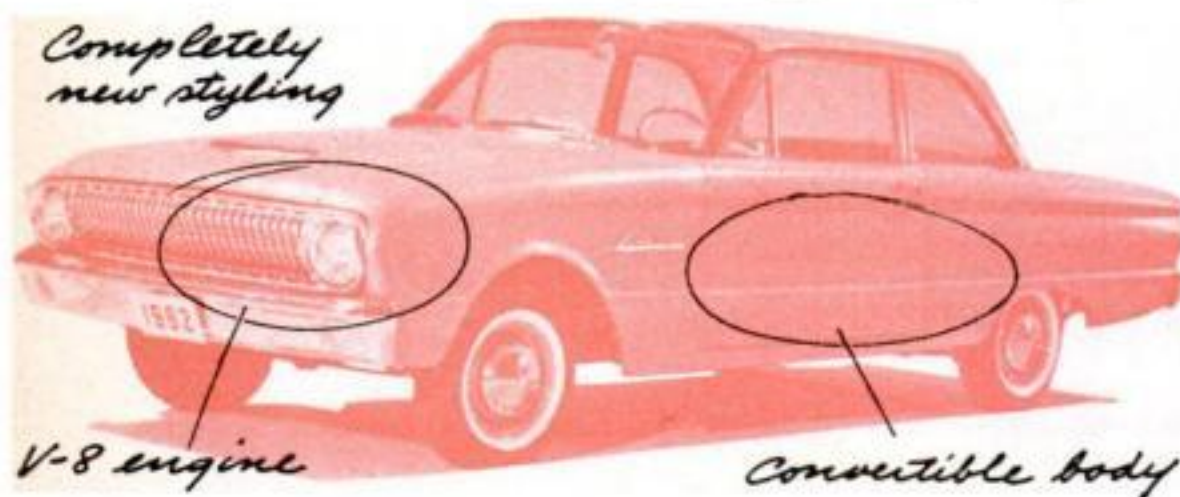
line Ambassador will feature curved side windows. The grilles on the Classic and Ambassador will, of course, be refurbished. These two cars also will adopt alternators, pioneered by Chrysler, in place of generators. The E-stick manual shift introduced last year in the Rambler American, eliminat-

ing the clutch pedal, will be offered as an option on the Classic and Ambassador.

The 1963 and 1962 Rambler American will hardly be distinguishable from each other.

The vest-pocket Metropolitan has been dropped entirely from the line.

The Falcon: Ford Motor's biggest styling change



Biggest change—except one—at the Ford Motor Co. will be in the Galaxie, the big Ford. But this will be no tear-up, with pieces strewn all over the planning-room floor. In appearance, the car will be new “below the belt,” which is the separation point between the glassed-in “greenhouse” and the solid sheet metal. The deck area will continue to be big enough for a game of table tennis.

The middle-size Fairlane, introduced last year, will have a grille change, little more. But a hardtop and a complete line of station wagons will be added to the Fairlane

line. Don't believe rumors of a Fairlane convertible. There won't be one. Ford will have convertibles, however, in the Falcon and in Mercury's Meteor and Comet.

Ford's surprise restyling will occur in the popular Falcon. There will also be an optional V-8 engine.

Still a year off at Ford is a completely sealed cooling system, to be introduced in 1964 models. It will be “permanent” in the sense that the system will be maintenance-free for 60,000 miles, or four years, whichever comes first. Ford was tempted to make the new cooling system a standard item this fall, but deferred introduction to get a better reading on how its current 30,000-mile coolant is working out in the hands of motorists.

There are rumblings that Ford Motor will be in the showrooms with one complete line of cars by Sept. 1 to beat the rush of the heavy autumn announcements.

The Chevy: At last, a new and muscular six

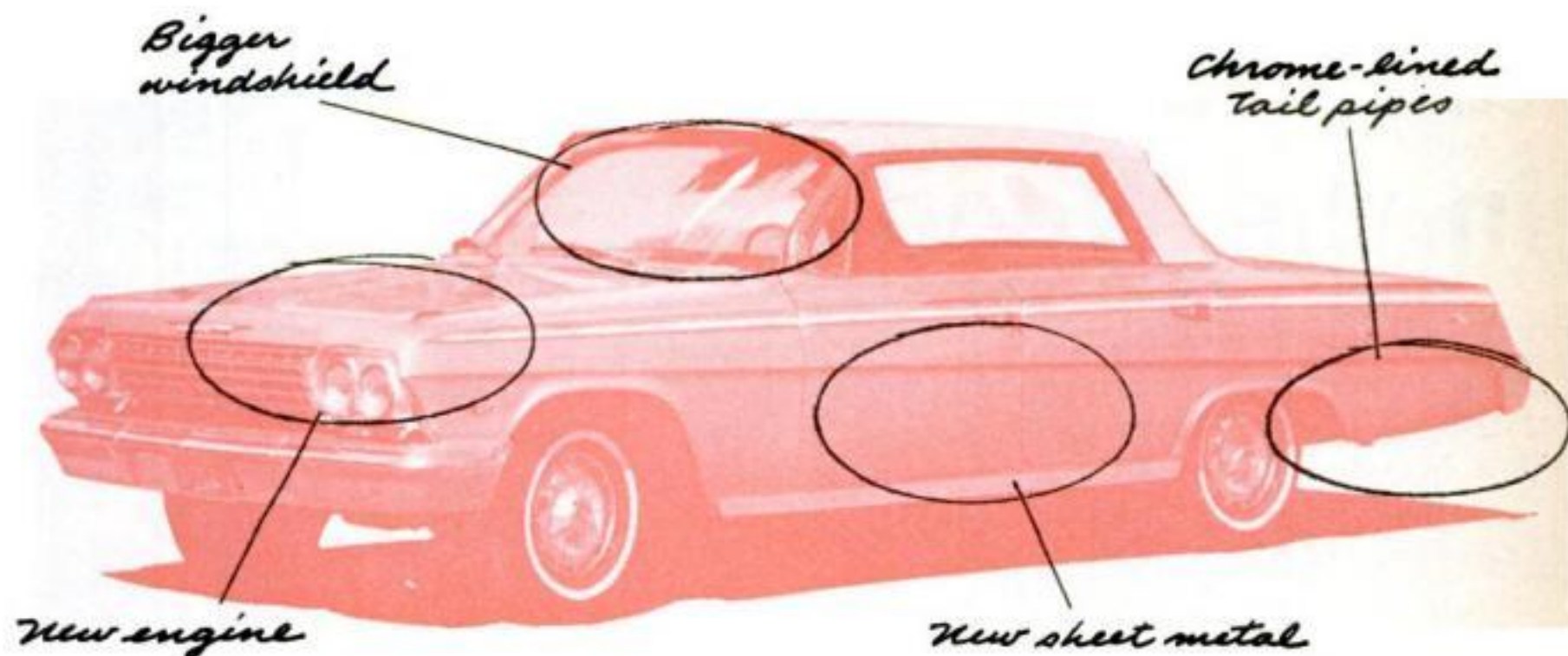
The regular Chevy, like Ford's Galaxie, will undergo a liberal face lift for a change in looks. A new windshield will afford more visibility. The Chevy II changes will be confined to a new grille.

The Corvair Monza 700 line, between the standard Corvair and razzmatazz Monza 900, will be dropped. So will the station wagon. Corvair's newish supercharged, 150-hp. Monza will be retained, and heavily promoted. For the third straight year, Corvair's obvious styling change will involve only the front “grille,” an awkward misnomer in a rear-engine car.

At long last, after five years of rumors, Chevy will have a successor to its sturdy, 25-year-old, six-cylinder overhead-valve engine. The Chevy six first



families of station wagons, and a wild rash of convertibles



appeared with a displacement of 216.5 cubic inches and 85 hp. Periodically in the intervening years the engine has undergone surgery to increase displacement until, for 1962, at 235 inches it produced 135 hp. The last big change occurred in 1954 when it was given pressure lubrication.

The new Chevy six will be about the same size but more muscular.

Chevy's matching midget car for the Ford Cardinal, the F-1100, was dead for 1963, and perhaps for all time, months before Ford's announcement that plans for Cardinal production in this country had been abandoned. And discount reports that Chevy will have a new-name car this fall. It has been deferred until 1964.

Chevy's Corvette will have new styling, adjustable shock absorbers, and an improved rear suspension for getting around turns with a minimum loss of traction. The transmission and engine options will be unchanged.

Chevy will use chrome to lengthen the

life of its tail pipes on twin-pipe models. Powdered, the chrome will be diffused into the interior surfaces by heat treatment. The result is described as more durable than aluminized steel.

Buick will bring out a Thunderbird-like, sports-type automobile. This is not to be confused with the Wildcat, which is a dressed-up Invicta. With completely new sheet metal, the new car will match Ford's T-Bird in price (close to \$5,000 with optional equipment) and power (from 300 horses up). Probable production for the year: 80,000.

Nor will the Wildcat be forgotten. In new dress, even flossier, it will still cost less than \$4,000.

Rumors to the contrary notwithstanding, Buick will not drop its aluminum V-8 engine in the Special. But Pontiac's Tempest will. The Tempest's husky, four-cylinder engine, in compensation, will have a supercharger option designed after the Corvair's, not the high-compression Olds F-85's.

The Studebaker Lark: Moving up into bulkier company

Studebaker's announcement of the Avanti sports car last spring was only a foretaste of what was to come. Be prepared for a bigger, flashier Lark bearing no resemblance to its immediate forebears. The glass area and plush interiors will be dramatic. ■ ■



A New Way to Find Yourself in the Woods

A HIGH-SCHOOL senior from Falls Church, Va., has come up with a neat new way to find your bearings if you're lost in the woods. It's simple enough (see sketches) for Cub Scouts and so reliable that the Army expects to adopt it. Said the Ranger captain who checked it out: "The best I've ever seen."

Bob Owendoff was studying sun dials for a science-fair project when he discovered his "shadow-tip" method. It requires no knowledge of stars or planets and no instruments. All you need is a fairly straight stick, level ground, and enough sunlight to cast a shadow of the stick. If the sun is weak, tapping the top of the stick with your finger will make the shadow tip easier to spot.

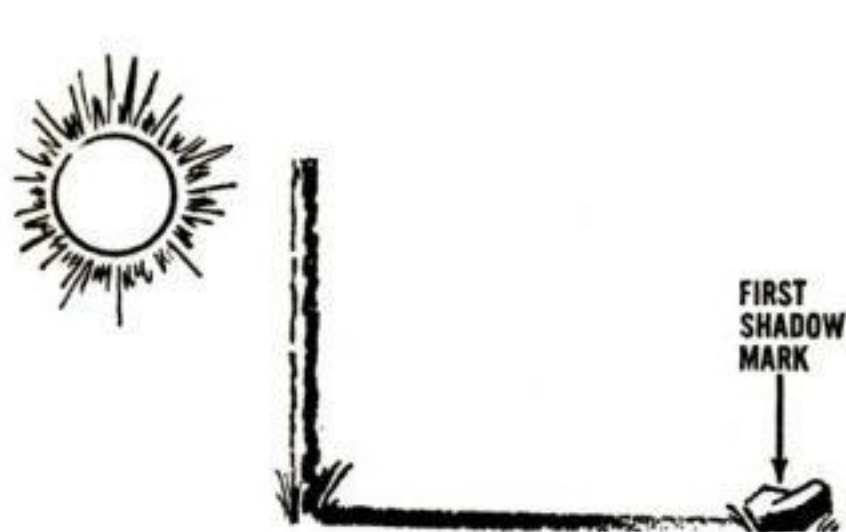
This crude setup will also tell time. You just draw a line parallel to the east-west line through the stick base. Then add a semicircle between the two parallels and centered on the stick. The shadow serves as a moving hour hand. Noon is the north line, 6 p.m. the east end of the semicircle.

Surprisingly, Owendoff's shadow-tip bearings are more accurate than a compass's. The error from true north averages five degrees, but is less than that near midday and greater in early morning or late afternoon. A compass deviates an average 12 degrees from true north in the U.S.

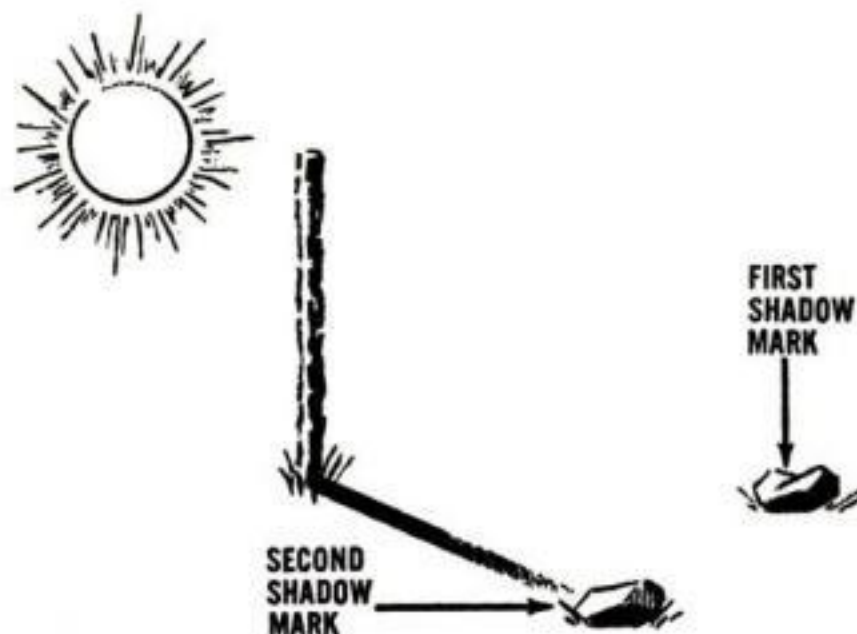
Owendoff has prepared a booklet describing his technique in detail. He sells it (25¢ a copy) from his home, 153 Gundry Drive, Falls Church, Va.



Young Bob Owendoff



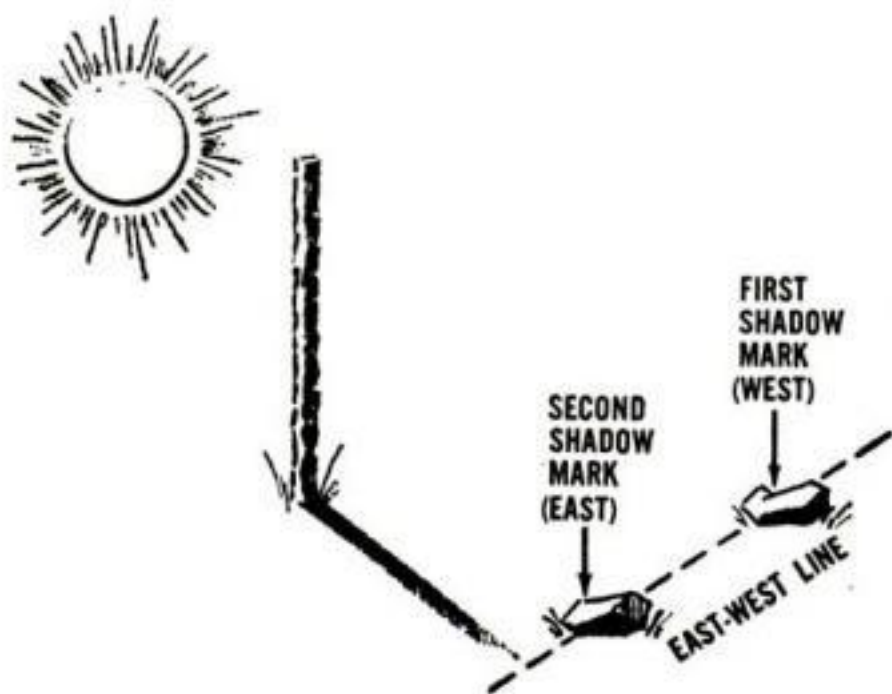
1 Stand a straight stick, three or four feet long, in clear, level ground. Mark the tip of the shadow cast by the stick with a stone.



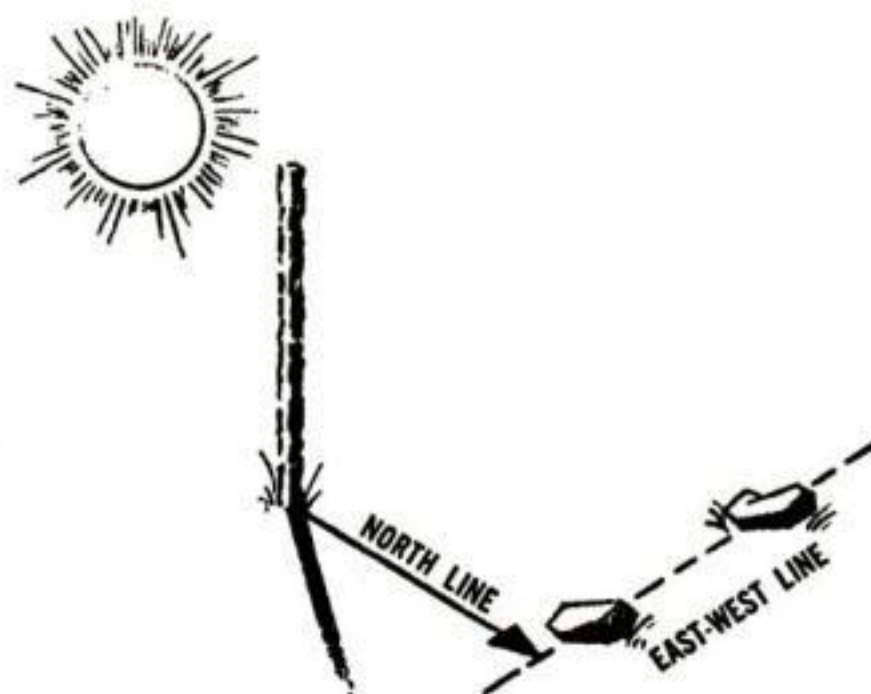
2 Watch the shadow until the tip moves over the ground. A few minutes is enough. Mark this second shadow point with another stone.



demonstrates his simple shadow-tip technique for finding bearings. Equipment needed: a stick.



3 Draw a straight line passing through both stones. This line runs east and west. The first stone is at the west end of the line.



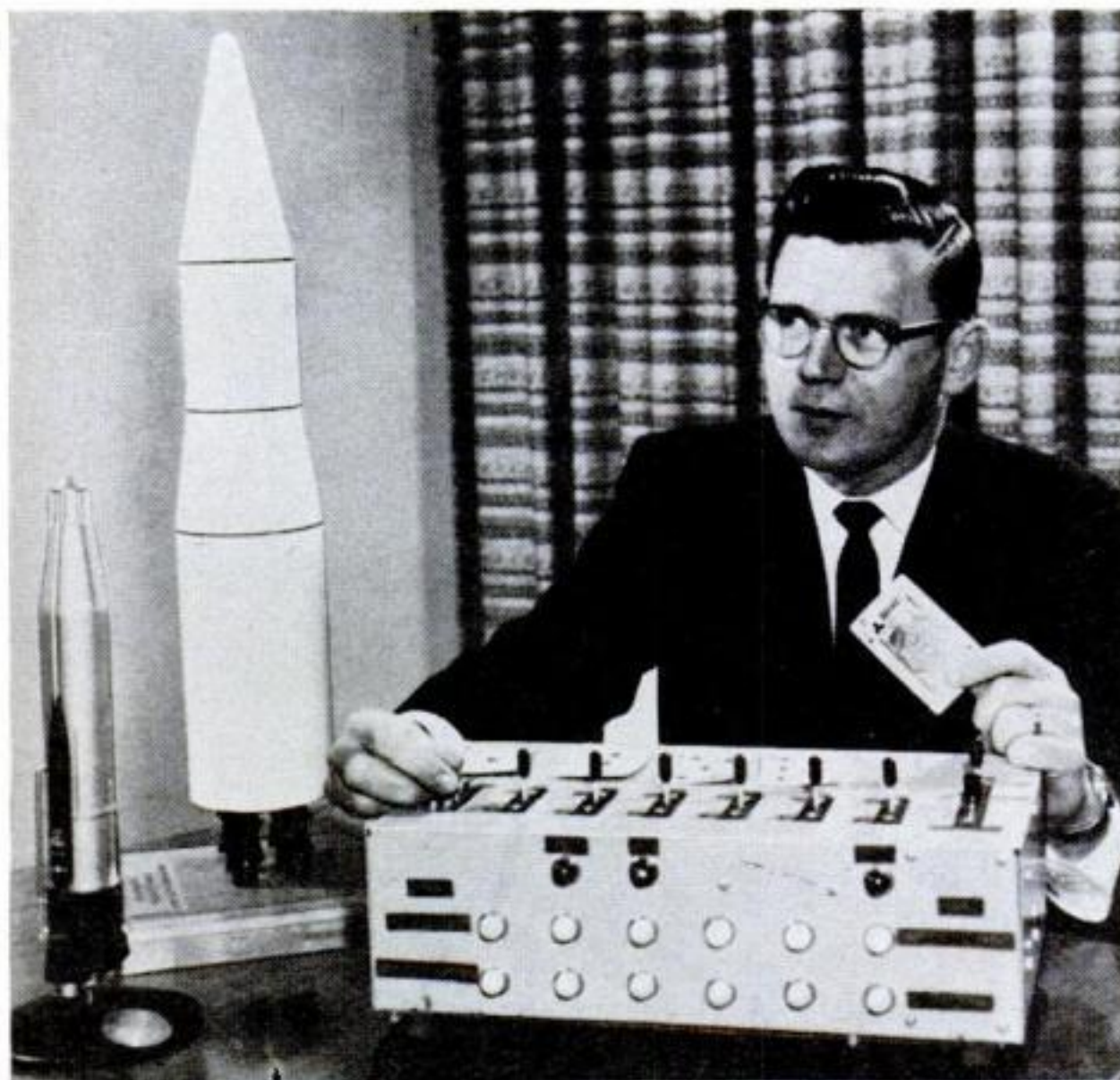
4 Draw the shortest line from the base of the stick to the east-west line. This points straight north (in the Northern Hemisphere).



Cross-country freight train travels on 10-foot tires

A 572-foot-long all-aluminum overland train will deliver 150 tons of supplies to Army outposts over snowfields, desert, or rough ground without benefit of roads or

railway tracks. It's like an earlier version [PS, July '55], but much larger and more powerful. Each of its 54 wheels is propelled by an electric motor in the hub. They draw



Machine learns from its mistakes

The electronic box at left learns lessons like a child. Coded questions are put to it by its teacher, who presses a "punish" lever if it answers incorrectly. After six or eight punishments, the "pupil" learns by trial and error to recognize a playing card (shown being demonstrated by a General Electric official), and from then on it comes up with the right response.

The machine, by its ability to recognize patterns, is expected to help interpret Russian space and missile activity.



juice from gas-turbine generators located in two trailing power cars. The rubber-tired train is driven by a single operator in a control car up front.

The control car has an auxiliary generator, quarters for a crew of six, complete

navigational equipment including radar antenna (visible on top of cab), and is insulated and air-conditioned for tropic heat or arctic cold. The train, built by R. G. LeTourneau, normally consists of 13 cars (only 12 are shown in the photo).



Fishing boat skims shallow water

Three styrofoam floats and a frame of lightweight-aluminum electric conduit take this boat among the reeds and in shallow water where the fish are biting. Heaviest

part is a 37-pound car battery that powers a two-pound electric motor. It turns a hand-made brass propeller for speeds up to seven m.p.h. Steering is by an aluminum rudder. J. A. Wagon, Sherman, Tex., expects to have a modified version in production soon.

Dam Russians

...I watched
them plugging up
the Nile

In 1970 an aerial photo of giant construction job should look like this, with generators and spillways complete. Filling 310-mile lake behind dam may take even longer.

SOUTH

MAXIMUM WATER LEVEL: 321 FT. ABOVE RIVER BED

MINIMUM WATER LEVEL: 207 FT.

UPSTREAM COFFERDAM:
164 FT. HIGH

CLAY BLANKET

Sectional view of finished dam shows how it will incorporate three individual dams and a central barrier running down to bedrock. Nile flows from south to north (to right).



Aswan today: a sea of granite and rubble, almost too hot to touch under Egyptian sun.

By Wesley S. Griswold

Aswan, Egypt

WHEN I stepped off the dusty Cairo Express into the hot, fly-blown streets of this ancient town 600 miles south of Egypt's capital, I found it hard to believe that one of the engineering marvels of the 20th century was taking shape close by.

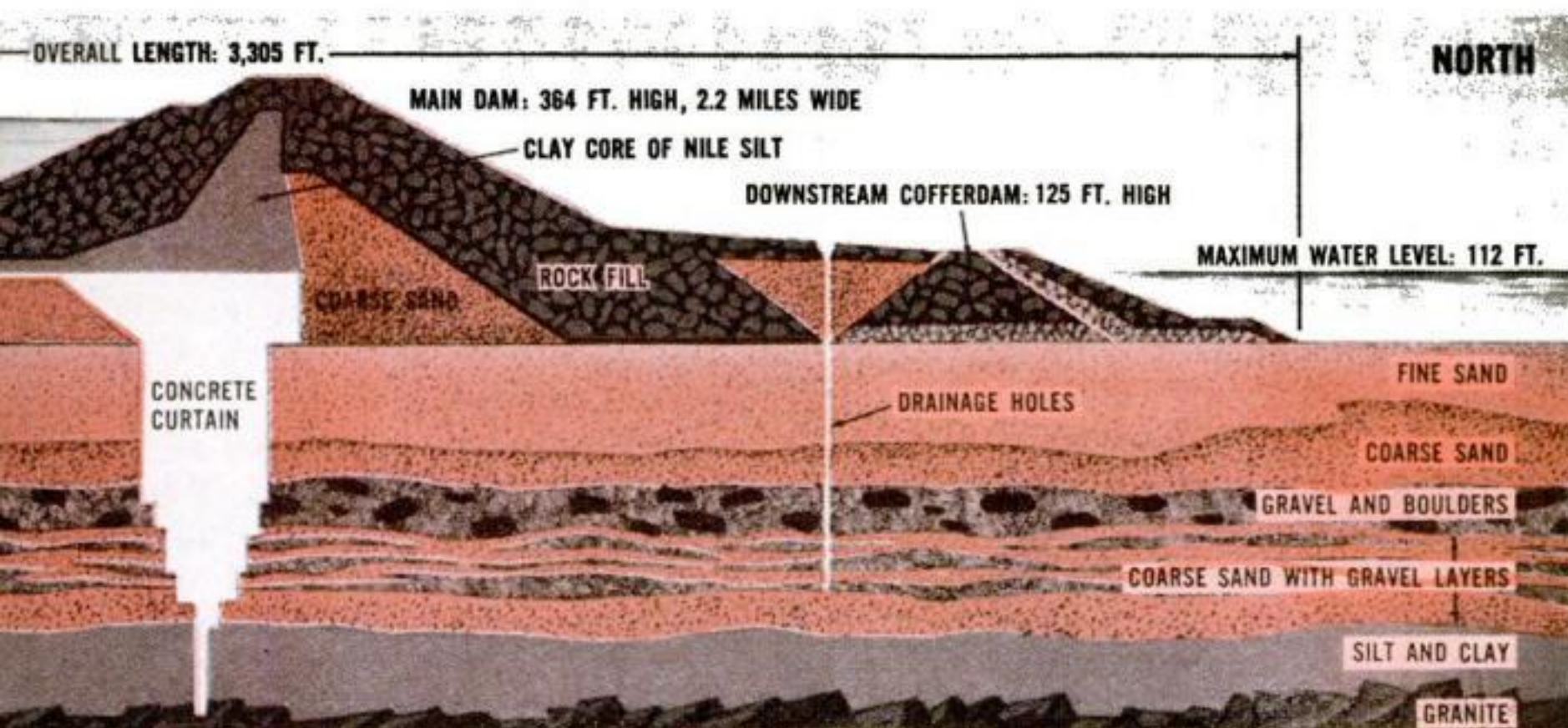
If it weren't for the salvos of distant blasting, it would be far easier to imagine Aswan as it was 4,500 years ago: a busy frontier town trading in gold, ivory, peacock feathers, and scented woods brought in by caravan.

Aswan today strives to look modern. A macadamized drive skirts the Nile, and a sprinkling of neon lights colors the river-front shops. Yet sacrificial sheep are still slaughtered in the back streets, and barefoot Arabs are more familiar sights than automobiles.

But a few miles south of the mud-and-straw houses that border the town, 7,000 Egyptians and 460 Russians are struggling to build the Aswan High Dam.

When completed, this artificial mountain will bring the longest, most famous, and most fickle river on earth under man's absolute control. Behind the dam's 364-foot-high pyramiding wall of granite, clay, sand, and concrete, the world's largest man-made lake will rise. The Nile's waters, sluicing through the dam's spillways, will power a 2.4-million-kilowatt electric generating station.

The 104 million acre-foot ($4\frac{1}{2}$ trillion cubic feet) lake-reservoir will put an end forever to the flood-and-drought existence that has plagued Egypt through its 6,000 years of recorded history. It will bring into cultivation a million acres of now-barren land as well as triple the present one-crop-a-year yield of existing farmland.



CONTINUED



Swallowing rock on the eastern shore of the Nile is one of the big electric shovels the Russians brought in. Work in the first year of the project (1960) went to building roads and railway. Excavators are now digging the diversionary canal, creating granite rubble that, in a few years, will make dam itself.

Water to make a million acres fertile and create 2.4 million

The power plant—producing eight times Egypt's present output of electricity—will be a crucial force in bringing the country up to 20th-century standards, sparking a dozen new industries from oil refineries to textile mills.

It is no wonder that the High Dam takes on an almost mystical significance for Egyptians—a work grander and infinitely more complex even than the building of the Great Pyramid at Giza. (The dam's mass is 16 times as large.) The terrain—a clump of bare hills of smutty gray granite tinged with red—is forbiddingly stark. But even worse is the weather. Here at the dam site the sun's rays are so fierce that except in winter most work is done at night.

Even in mid-April when I was there, the days were so hot that workers would blister their hands if they touched metal exposed to the burning sun. But at dusk thousands of gowned laborers flock to work in the surprisingly cool evening. The area, guarded by soldiers in brown fatigue uniforms and vivid in the glare of brilliant floodlights, was one of frantic activity the night I saw it.

My guide was an affable Egyptian engineer for the High Dam Authority. Our car was a little Volga sedan, brisk and well-sprung. It was a reminder of the Russians' presence, for, in the tug of cold war in the Middle East, it was the Russians who finally decided to lend technical and financial aid to the Egyptians in their 10-year, billion-dollar project.

At the first shadowy street corner the horn-happy Nubian driver hooted around the bend and our headlights shone on a blond young man in shirt sleeves beside an equally blond girl. The engineer sharply ordered the driver to stop. He leaned out and, in English, invited the couple to ride with us.

Doubtful accent. The young man, speaking English with what I took to be a German accent, apologized for "inconveniencing" us.

We bolted onward in polite but awkward silence. The road, winding circuitously through 10 or 11 miles of rough ground, reaches a point less than 5 miles upstream from Aswan.

Midway we came to an impressive block of apartment houses. The Egyptian ordered the car stopped and the young couple got out, thanking us graciously.

It suddenly dawned on me that these were no German tourists.

The engineer seemed to read my mind. "No," he said, "they are Russian."

"Are they as easy to get along with as they seem?" I asked.

The engineer was diplomatic. "We have fraternal meetings at which we discuss our problems of building the dam, and decide how to proceed."

When we arrived at the site, 10 huge electric shovels, their lighted interiors as large as living rooms, were biting into the debris of the day's dynamiting, the one daytime activity that does go on. With shattering clatter they dropped

International palaver: Interpreter at left passes on instructions from Russian engineer in center to an Egyptian colleague. Relations are polite but remote; off the job the Russians stick close to their new apartments between site and town. Most of the heavy equipment in use was brought in from USSR by ship and rail.



Business Week

kilowatts of power is promised by the Aswan High Dam

their four-cubic-yard mouthfuls of rock into waiting 25-ton dump trucks.

"Are Russians operating them?" I yelled.

The engineer nodded. "With Egyptian assistants," he yelled back.

Electric cables feeding power to the excavators curled like long, fat snakes across the thick rock dust.

Twin-diesel dump trucks—there are 97 of these big ones at the site—had wheels at least eight feet high. They towered over our little Volga as we scrambled to get out of their headlong way. The rock was enroute to a collecting dump, from which it would later be taken to give bulk and strength to the future dam.

Well above our heads, on a perpendicular cliff, a row of drilling machines chattered continuously, making holes for the next day's blasting charges.

The High Dam is being built in two stages. The first, under way since President Gamal Abdel Nasser opened the project in January, 1960, consists of blasting out a channel to detour the Nile around the main dam and flank it with cofferdams to keep the site dry. The detour will be a concrete-lined canal a little over a mile long, 164 feet wide, and 115 feet deep. Where the canal crosses the center line of the dam, six tunnels will be bored through the virgin rock. The Nile, thrusting through those tunnels, will eventually spin a long row of 175,000-kw. dynamos.

The diversion canal, now about a

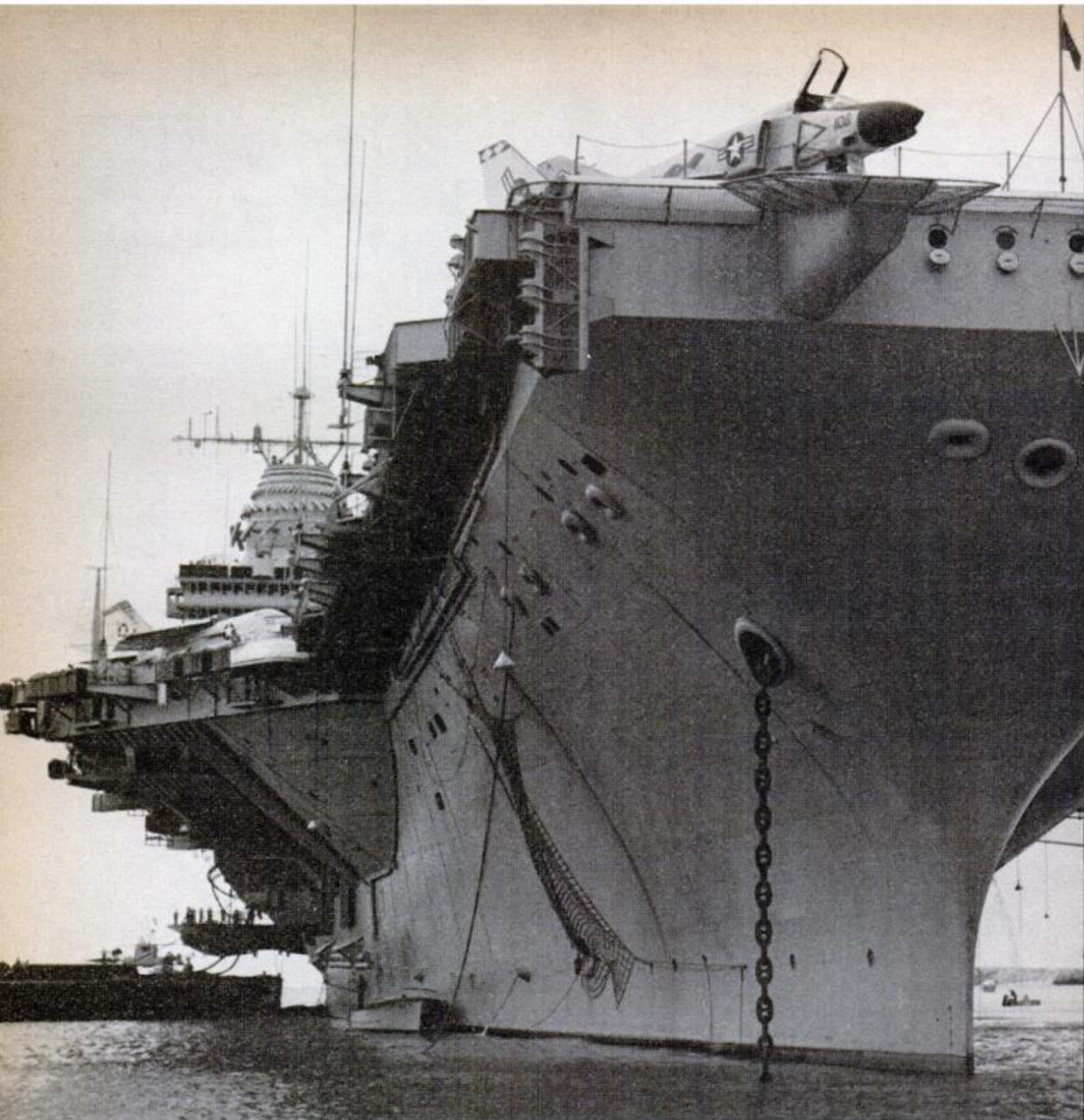
third finished, is scheduled to be ready by the summer of 1963.

The upstream cofferdam will then be built to steer the river into its new bed. Downstream, the second cofferdam will prevent river water from seeping back onto the dam site after its detour.

The second stage is the building of the main dam itself. Some 126,000,000 tons of granite chunks will be heaped around an impermeable horizontal blanket of clay, with a vertical curtain of concrete reaching down 690 feet to bed-rock. This stage can't be begun until the canal and cofferdams are in place—about 1965. Five more years should complete the dam and the power plant that goes with it.

The Russians plan to build the cofferdams by dumping rock debris into the Nile from both banks. Trucks will haul the rock out to midstream over pontoon bridges. To keep the river from leaking through the pile of granite rubble, the Russians will try a simple but controversial scheme: They plan to dump sand upstream from the crude rock wall. The sand will sift between the rocks to plug any holes. So the Russians expect—for they used the same technique on a Dnieper River dam.

Some Western engineers have their doubts. Nobody has ever used the method on such a large scale before, and the only way to find out is to try. With the world watching, the Russians seem confident that they won't fail. ■ ■

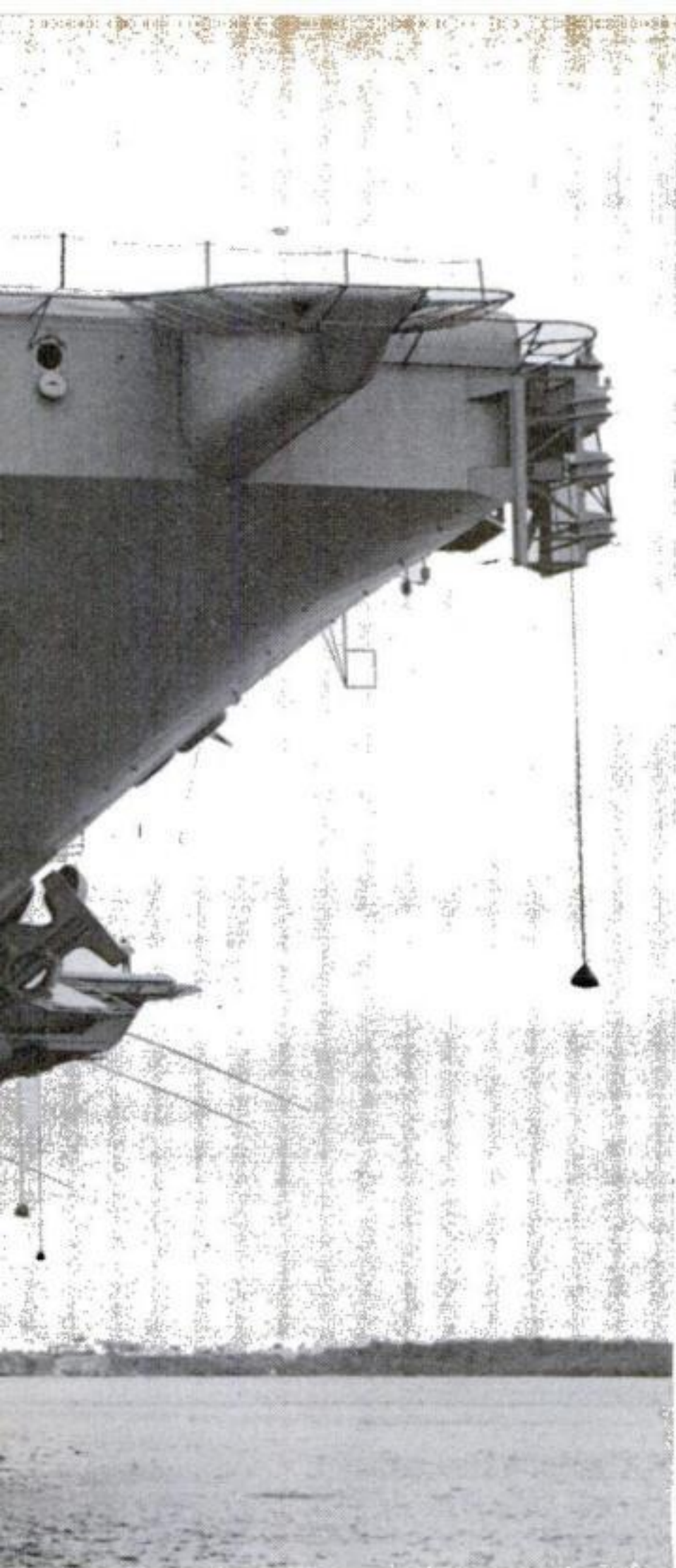


Atomic-powered USS Enterprise can foam around the world wide-open—and unleash a

Grab the rail and brace yourself to ride this—

85,000-Ton

Mightiest of warships, our Navy's new carrier Enterprise travels faster than 40 m.p.h. to deliver its H-bomb wallop



PHOTOS BY W. W. MORRIS

strike in 10 minutes' plane-launching time

Hot Rod

"Hat" atop square island of ship is electronics-countermeasures weapon to confuse enemy bombers. Flat sides are super-long-range radar antennas.

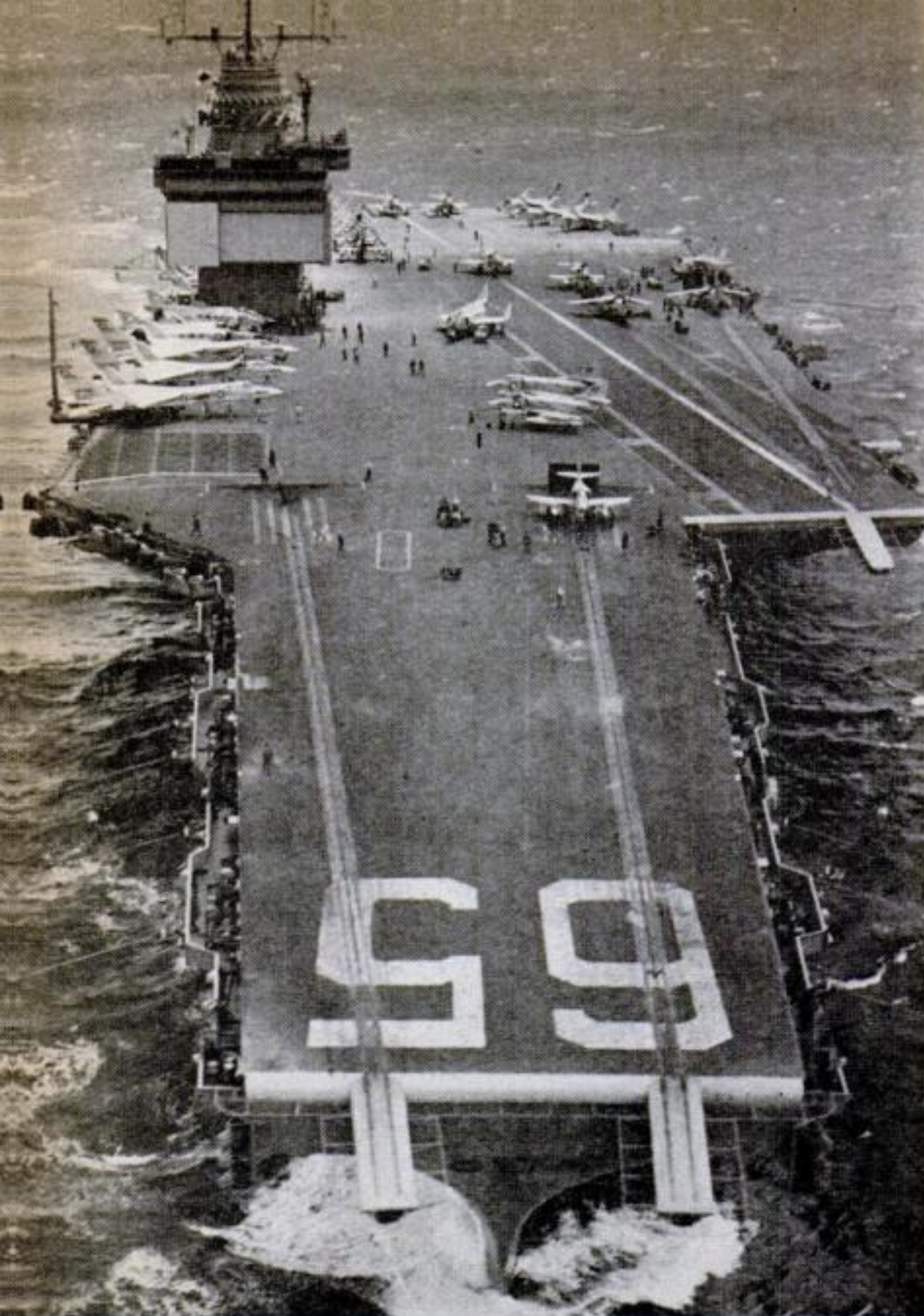
By Frank Harvey

I STOOD at the rail of an observation deck high on the "pagoda" island. I wore ear-defenders—sponge rubber and plastic cups, like earphones—shoved back off my ears. A nearby speaker crackled: "Fasten all helmets and goggles. Check all loose gear about the deck. Stand by to start jets."

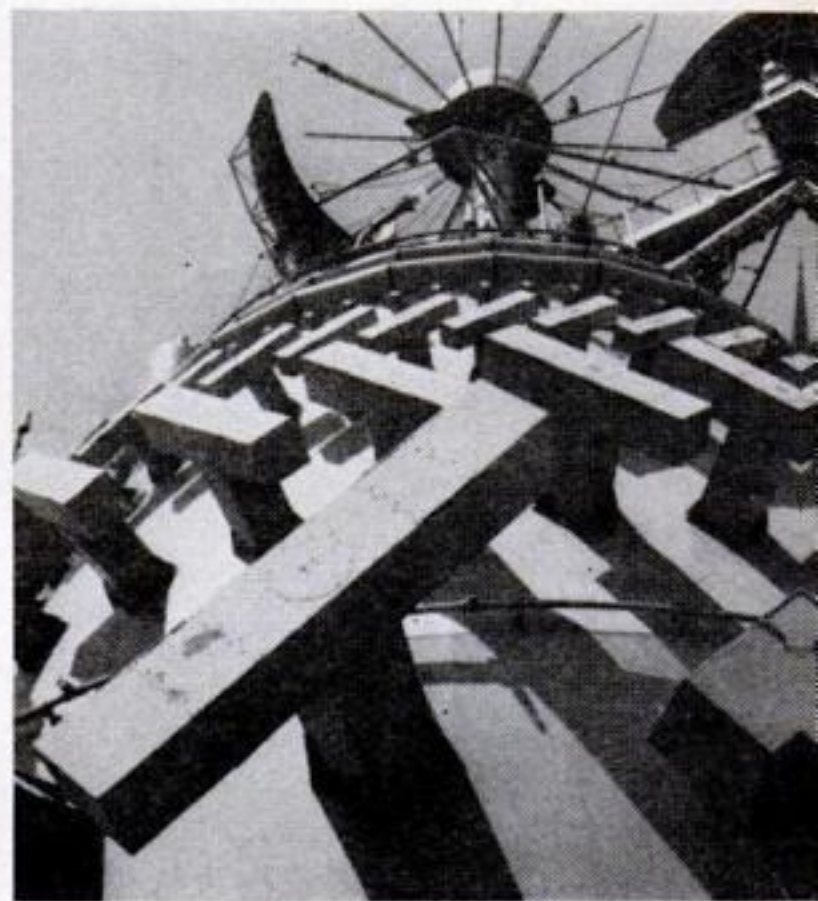
The brand-new nuclear-powered USS Enterprise, deadliest carrier in the world, had been loafing along through the dark-blue water of the Caribbean. Weighing 85,350 tons fully loaded, 1,123 feet long, crewed by 4,600 officers and men, capable of speed "in excess of 40 m.p.h.," this monster can circle the world at full throttle, and run for years without refueling. She can stand a thousand miles off an enemy shore and send in A3J Vigilantes, laden with huge multimegaton bombs. Or she can slash in close and catapult off her "Tinkertoy" bombers—tiny A4D Skyhawks—and her veteran prop-driven AD Skyraiders, laden with rockets, napalm, and assorted bombs, for close support of troops that are fighting a brushfire war.

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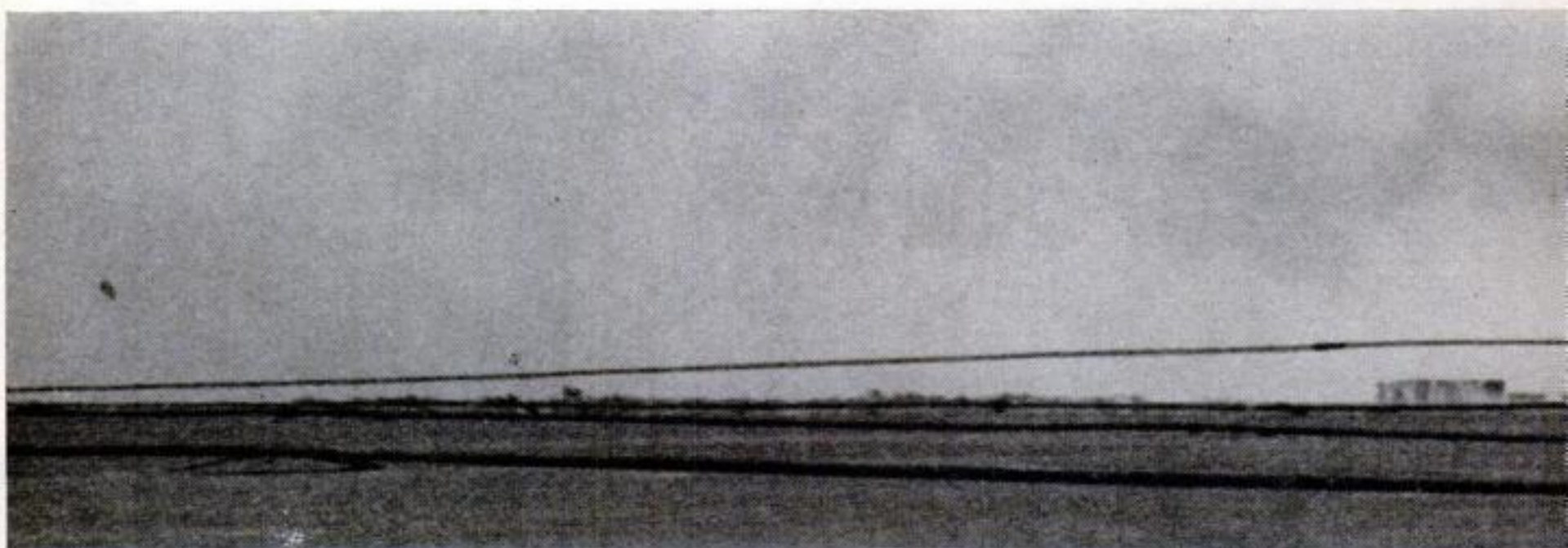
Portrait of doom: Oncoming Enterprise—unlimited in range, outpacing subs, guarded from air attack by jets and radar—cannot be prevented from launching massive H-bomb strike at place and time of its choosing.



Mysterious metal outgrowths seen in close-up of ECM (electronics countermeasures) Cap—the "hat" on carrier's island—contain secret gear to put an air attacker's radar out of business.

So fast she can run away from conventional subs without opening her throttle, the Enterprise can't be caught even by nuclear subs when she digs out in earnest. And she's protected from the air by her

screen of F4H Phantom IIs, the world's fastest interceptors [See "I Rode Our Hottest Jet," PS, May '62], and by an electronic brain that reacts faster than a man touching a hot stove. The big carrier pre-



GROWWOOM! snarls tailpipe of Crusader jet as wheels hit big carrier's deck. Pilot rams on

Stern of ship has a chopped-off look. It's built that way so it can dig out like a speedboat when skipper pours on the power.



sumably can't be sunk by anything short of saturation swarms of bombers. Even should she die in such an attack, it won't be until she's catted off enough nuclear fury to vaporize a large section of any hostile nation.

The pagoda island on which I stood is unlike that on any other carrier ever built. The eight atomic reactors deep in the hull (rated to deliver 200,000 shaft hp.) need no exhaust stacks to steal island space. Instead, the structure is planned from the beginning to help the men who "fight the ship."

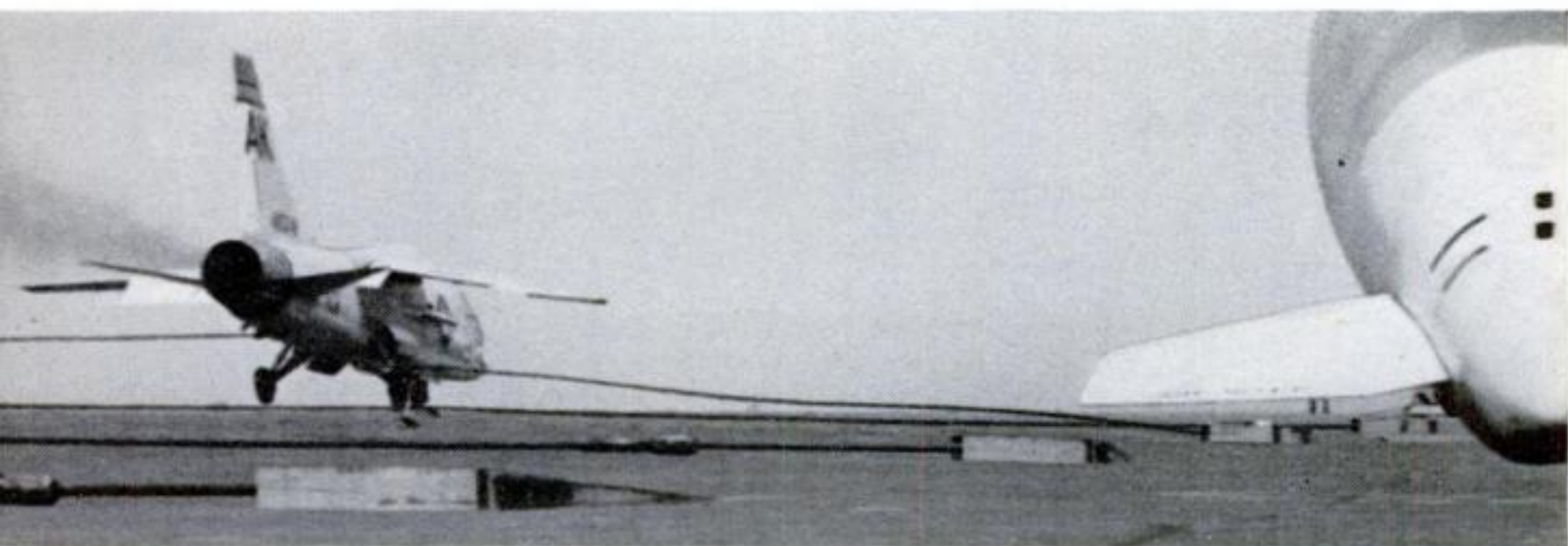
The great slabs that wall the pagoda island are huge radar antennas, immensely effective because of their size. The tricky shapes that sprout from the dome are secret electronic defenses. Inside the island, a high-speed elevator carries the Captain, the Air Boss, and other key men to their stations.

The bow of the carrier, so far forward and below my station on the observation deck that it hardly seemed a part of the same ship, now began to turn smoothly to port. Wind-over-the-deck sprang up

and shifted. I glanced aft. The frizzle of foam from the four 21-foot screws was changing rapidly to a highway of white froth. Jet engines began a hypodermic whine that shifted into a pressure-stove hissing. An oil-lamp stench of burnt jet fuel eddied up from the now hoarsely roaring deck.

The white path of foam behind the giant carrier curved sharply, pulling a huge glassy slick, as the Enterprise came squarely into the wind. My body staggered against the wind pressure; I pulled down my goggles and braced against the rail. In seconds the huge ship was at full speed, like a hot rod in a drag race. Her giant stern squatted. A rooster-tail of foam spewed backward on the wake, now as wide as a city block.

Swarming crews of plane handlers down on the deck began goading the jets into position for takeoff, their colored jerseys bright in the sunlight. I'd memorized the code: red for ordnance, green for catapults and arresting gear, blue for fuel, brown for mechs and plane captains, and yellow for directors. From my height



full power to be ready to take off again, if plane's tailhook fails to snag cable of arresting gear.

CONTINUED

they looked like furious ants darting around sleepy bumblebees.

A blast of sound, too savage to tolerate, tore at my eardrums and I slipped the headset into place. There was a flash of motion and an F8U fighter leaped forward from the waist catapult. It climbed swiftly away trailing brown smoke, and the wire-rope bridle slid quickly back along its groove in the deck amid seething tatters of steam.

The cat shots came fast—every 10 or 15 seconds. Sometimes three planes were in the air at once off the bow. An F4H howled forward with its afterburners blazing, wallowing at a high angle of attack as it left the deck, and pulled away to starboard. A big A3J rolled up to the vacant spot with the distinctive lost-soul wail of a Vigilante's engines. Tough, flat-bellied sailors flung themselves on their backs between the bomber's wheels, feverishly attaching the launch bridle and the holdback. The jet-blast shield, which had flattened itself into the deck to allow the A3J to roll up, now rose quickly. The catapult officer made his checks and wound his arm over his head. The bomber's afterburners glared like two white-hot eyes, and off screamed the A3J.

In less than 10 minutes the ship had flung 26 jets and eight prop planes into the air. They were a mixed lot, with mixed capabilities and duties. I counted six different types:

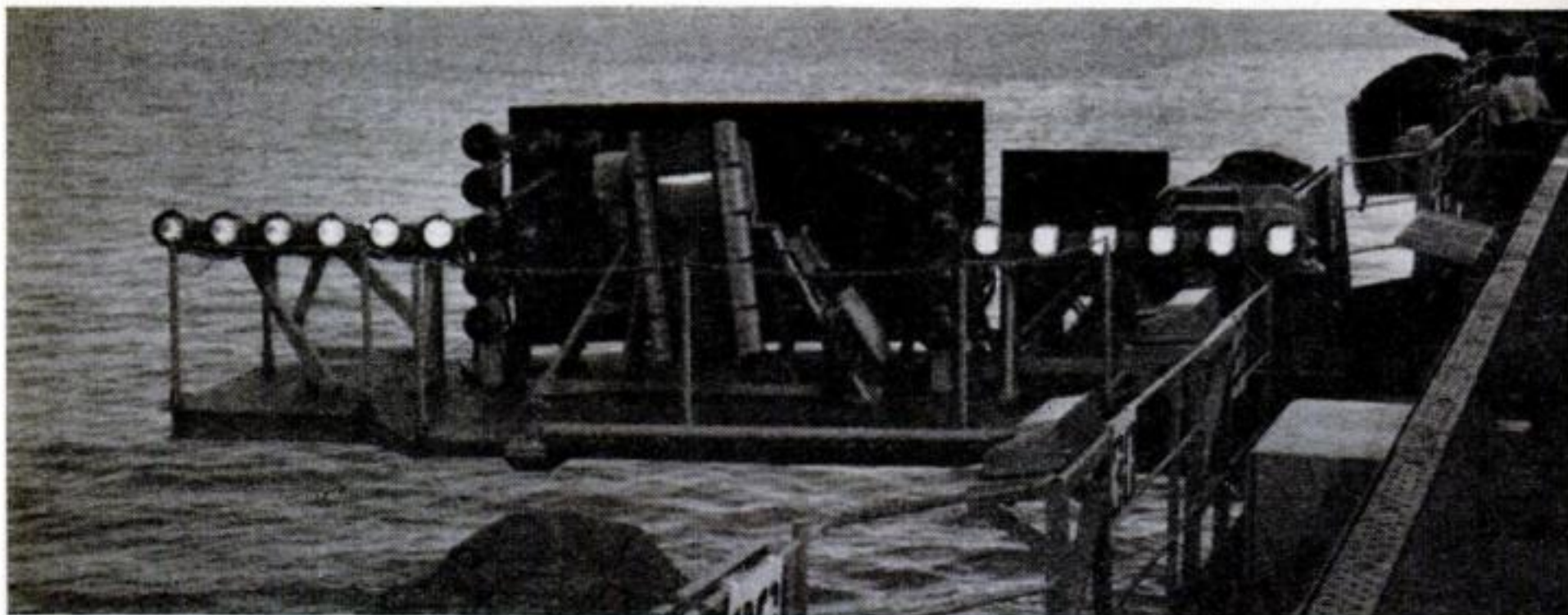
1. The prop-driven WF, known on shipboard as a "Willie Fud." Carrying a swollen radome over its fuselage, the Willie Fud is an aerial picket that sweeps the sea for attackers. Its sensitive MTI (moving-target indicator) not only searches the sky but also can separate a low-flying attacker from the "sea clutter" on radar.

2. The F4H Phantom II, presently the world's hottest jet, is capable of serving both as an interceptor and a bomber. But its primary carrier duty is to guard the ship. It ranges far out, carrying guided missiles, and is vectored to the enemy by ship's radar or by a Willie Fud.

3. The F8U Crusader is a high-speed interceptor, its function purely defensive. A mean, hot ship, its carrier landings have been called "controlled crashes." On the Enterprise they keep the F8Us in "Condition Alert"—two planes on the waist cats at all times, manned and ready for launch in seconds.

4. The A4D Skyhawk, a small bomber, can strike almost any kind of target. A day bomber and without great range, it nevertheless could be invaluable in something like the Korean War. Led by a pathfinder at night or in heavy weather, to drop on signal, it could have its range doubled by buddy-system refueling.

5. The AD Skyraider, a prop-driven plane, is old as military aircraft go but so



Over-water landing light—new on the Enterprise—is out of the way on the ship's port side. When a pilot has lined up its glowing orange

bar with another green one, he knows he's "in the groove." Formerly landing lights on our flattops took up valuable deck space.



An A4D Skyhawk, America's smallest jet bomber, rides past Enterprise's bow wave on a new

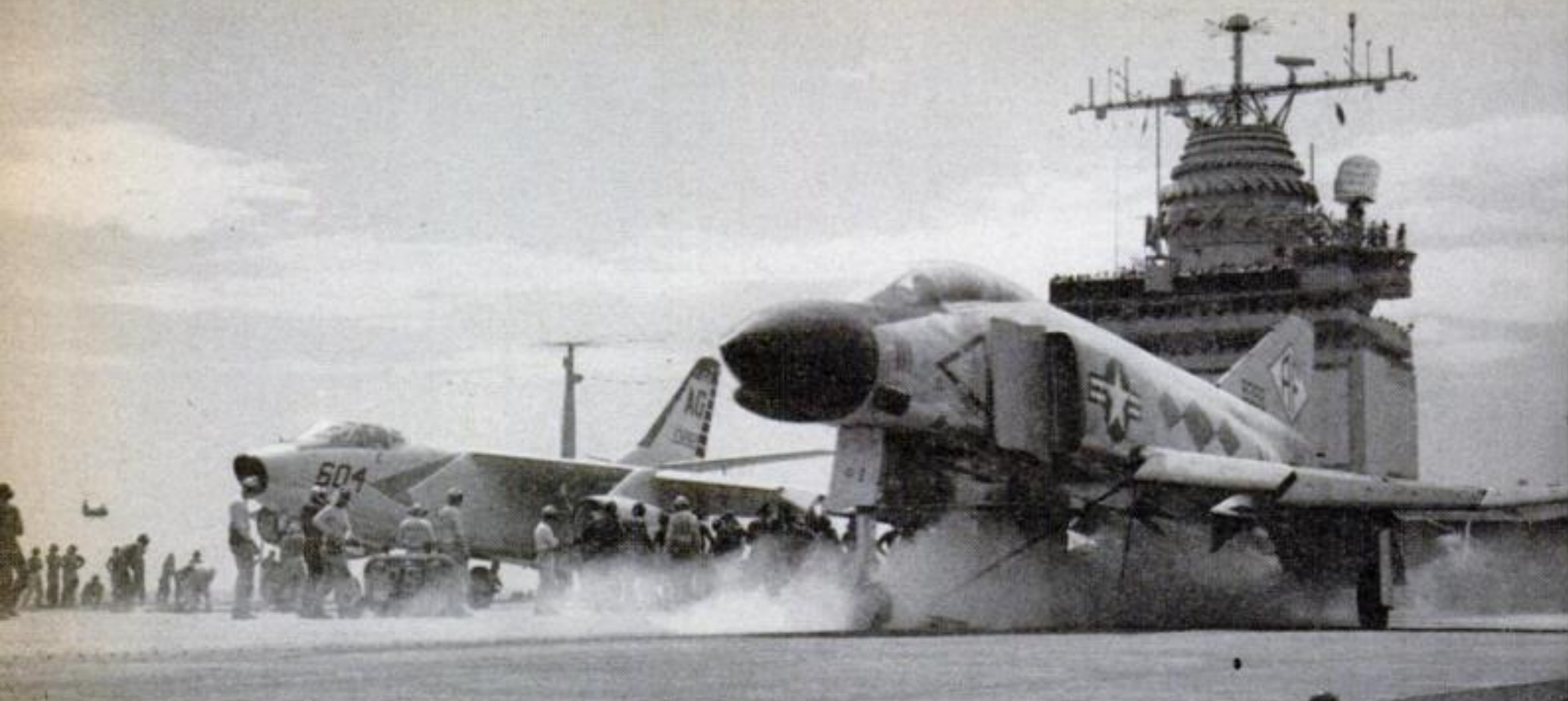
lightweight deck-edge elevator. These tiny but potent craft deliver close-in nuclear punch.

good there's talk of retooling to build it again. Though slow and vulnerable, this bird carries like a Mack truck, freighted with all kinds of weapons.

6. The A3J Vigilante, the carrier's haymaker, is essentially a heartland attacker. It can strike deep into a nearby continent, flying above 70,000 feet or coming in at virtually zero altitude to duck radar detection. It flies at Mach 2 and carries very "sophisticated" radar for night or all-weather bombing. A big two-engine jet, it shoots its big "thermonuke" out its tail

with a charge of explosive—for accuracy, and to enable the plane to survive the H-bomb's blast.

Over the bullhorn, the Air Boss's voice boomed: "The launch is now complete. Give me a ready deck forward for landing." The carrier did not slacken speed. Earlier that morning she'd launched about 40 planes, and now they were coming in. First I spotted swift-moving formations of tiny toys, streaking along like artillery shells. Then they slowed, sprouted wheels and tailhooks, and jockeyed



World's hottest fighter, the Navy's hulking-snouted Phantom II, squats on catapult while

around the "groove" behind the speeding ship.

The Enterprise has the fanciest landing-light system in the fleet. (Those paddle-waving landing officers of World War II were automated out of business years back.) The system is mounted completely off the deck on the port side, and the lights are self-contained, not flashed onto curved mirrors as on earlier ships. Enterprise pilots say that with the new

Life-or-death setting of arresting gear is made below decks. If a tiny Skyhawk hit cable adjusted for heavy Vigilante load, jolt could snap tailhook and plane would plunge into sea.



hookup boys scramble to get her ready—amid tatters of steam from a just-completed shot.

rig they get a better "meatball"—the glowing bar of light that a pilot must keep lined up with a green reference bar of lights.

Planes began to come in. They came steeply down the groove, settled hard on the steel deck, and caught one of four heavy arresting cables. This cable ran out alarmingly—so far it sometimes seemed that the luckless craft was going to roll off the canted deck into the sea. It's intentional; the relatively gentle deceleration saves wear and tear on hooks, planes, and pilots.

Jet landings on a carrier aren't gentle or safe operations, though, no matter how ingenious the arresting gear. When a pilot feels his wheels hit the deck he immediately shoves his throttle wide open. Then if he gets a "bolter"—fails to hook a wire and rolls unchecked down the deck—he has power enough to take off again. When he *does* hook a cable, he winds up for an instant with his plane howling bloody murder. The effect is violent and noisily alarming—but not dangerous.

Enterprise's green-jersey team of "hook chasers" have the dramatic flair of bull fighters. They ran out to see if the tailhook of a landing plane was properly



Glass-enclosed battle station in "pagoda" island overlooks flight deck. From his perch

there, Air Boss of Enterprise (center) directs launching and landing of the carrier's planes.

free of the wire when it stopped. They were lean as wolves, and as fast. If a hook caught, they'd dart in and hack it free, swivel-hip around like a halfback, fling up one arm in the all-clear gesture—and the cable would instantly start retrieving itself, ready for the next plane.

The hook chaser has a lively job. He runs the equivalent of scores of hundred-yard dashes in 10 or 15 minutes. At night he must race out in darkness, through what is never less than a 35-m.p.h. wind-over-the-deck, check the tailhook with a dim red flashlight, signal the retriever, and race back again. He risks getting blown overboard or burned by jet exhausts, sucked fatally into intakes, or run over as decisively as by a truck. For this—a coveted job, proudly held—he gets \$100 a month.

The eight nuclear reactors deep in the Enterprise's hull give our newest carrier spectacular advantages over her older, smaller sisters. To begin with, there's not only no smokestack but no smoke of the kind that churns from the island of other carriers. This keeps the ship clean and protects planes parked on deck from corrosion. More important, it provides maximum visibility for pilots coming in for a fast, tricky landing—which, by na-

ture, *every* jet landing on a carrier is.

Atomic power gives the Enterprise astonishing maneuverability. There's a mammoth 35-ton rudder behind *each* of the four screws. They're controlled by one small steering wheel, not much bigger than the one in your car. With a twist of the wheel, the Enterprise responds like a liberty boat; she can turn faster than any big ship afloat.

The Enterprise has almost unbelievable acceleration. This floating city can jump from dead slow to a real pantleg-flapper of a rush in a minute or so.

And, having reached top speed, the Enterprise, with its atomic fuel, can sustain that spectacular pace for an unlimited time.

[\[Continued on page 180\]](#)

How Enterprise Compares with Its World War II Namesake

Here's the difference between the latest "Big E," world's first nuclear-powered carrier, and the battle-famed "Big E" of 1938-1947:

	Nuclear Enterprise	WWII Enterprise
Length	1,123 feet	827 feet
Full-load displacement	85,000 tons	25,000 tons
Speed	More than 40 m.p.h. (sustained)	38.7 m.p.h. (briefly)
Power	200,000 hp. (from 8 nuclear reactors)	120,000 hp.
Complement	4,600 (400 officers, 4,200 men)	1,529 (82 officers, 1,447 men)

Beyond comparison, however, is the enormously greater striking power of the new Enterprise with its planes' H-bomb armament.



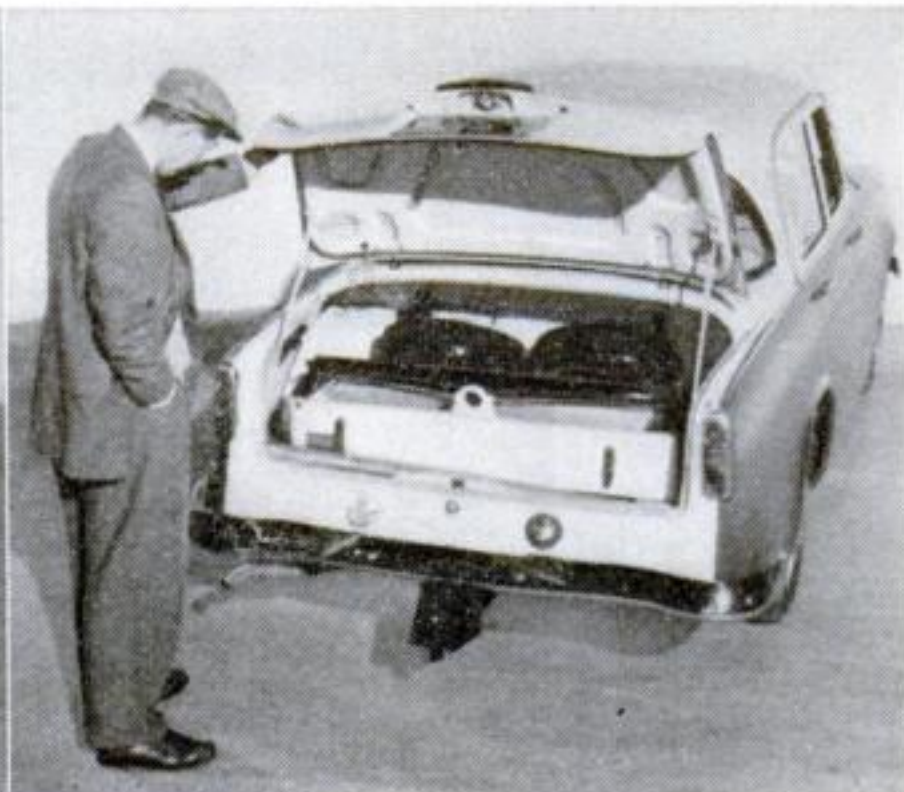
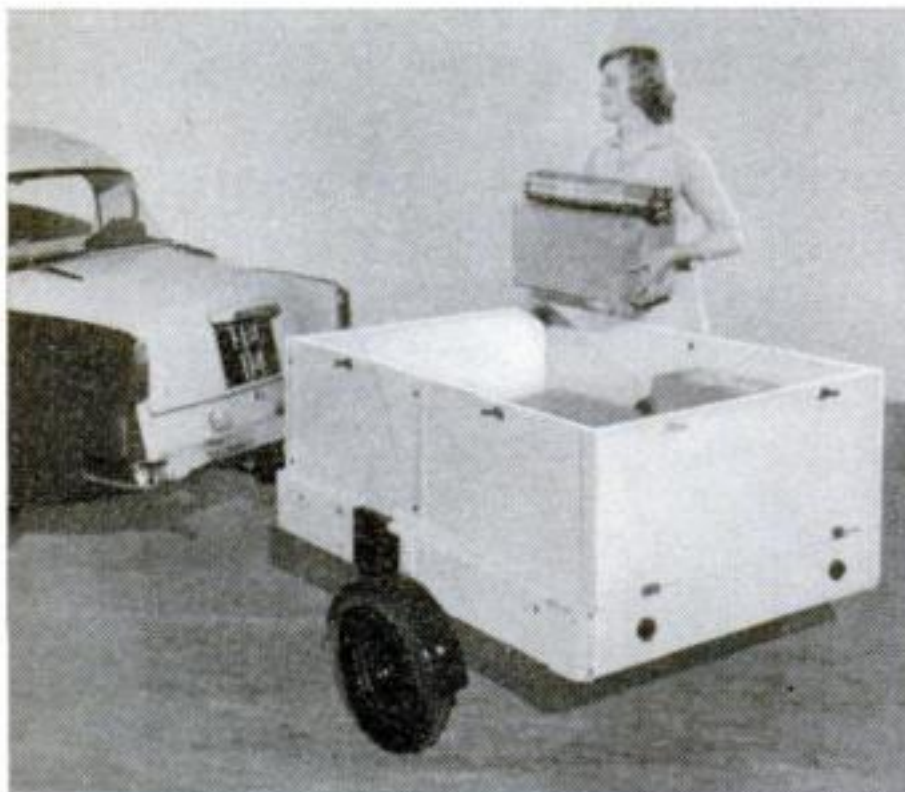
String of gas stations on barges is towed by tug to offshore anchoring sites for summer boaters.



Floating service stations

Barges equipped as filling stations now service small craft in popular boating areas near Stockholm, Sweden. Towed to offshore anchoring sites at the onset of warm weather, they eliminate the problem of dismantling or protecting dockside stations during the severe Scandinavian winters. In use, they are refueled from tankers.

◀ Barges stock gasoline and diesel fuel. Each barge can service five boats at a time.



Folding trailer hitchhikes as stowaway inside car

A telescoping aluminum floor, hinged sides, and a swinging tailboard that locks the structure in position make this little British trailer a useful part-time carrier of cargo or extra luggage. Towbar and wheels with torsion-bar springs click into place for

two-minute assembly. On unladen parts of a trip, it packs in the car trunk; or it can be stored in the garage in the space taken by a lawn mower. It's available with extension sides, a camping-tent superstructure, or a cradle for 15-foot boats.

What happens when a maniac sets a bomb? Here's the story of the Bomb Squad's race against time and death

The Job That Scares Everybody

By E. D. Fales Jr.

POLICE call it the world's most dangerous job. Most of them want no part of it. But for an adventurous few the Bomb Squad holds a frightening lure—even at two a.m. That was the hour, one night recently, when

a phone rang in the famous New York Bomb Squad's HQ. Detective Joe Mulligan took the call.

It came from CB, the police communications bureau: "Better get over to the Post Office. They got a box and it's ticking."

When an alarm comes to the B Squad, no one waits around. Mulligan grabbed his hat. As he went out he passed a sign that reminds B Squad men not to be heroes. Hung on the sign are



CONTINUED

With a roar like thunder, Big Bertha arrives to take the

bits of zinc, carbon, wire, and suitcase. The lettering over these says: "REMOVED FROM BODY OF DET. LYNCH."

Mulligan got to the Post Office minutes later, into a room cleared of clerks. Another "average busy day" had begun.

THE New York squad, which works closely with others in Miami, Kansas City, Chicago, and elsewhere, gets 1,000 calls a year. On a window sill in the squad room, three flights up in a building near the Brooklyn Bridge, are two grenades taken from a mail box. The doorstep is a three-inch shell. Various ominous objects lie around. Chief of the squad is Sgt. Kenneth O'Neil, a college-trained scientist who looks more like the chemist he is than a detective. His hand-picked squad consists mainly of 13 ex-GIs who were demolition frogmen or ordnance men.

The two a.m. alarm proved to be a dud. The "bomb" was a battery-powered shaver accidentally turned on in shipment. Two other calls, at five a.m. and eight a.m., were also false alarms. Then, at 10:08 a.m., came a call that really tightened the squad. CB phoned: "Suspicious object in a locker at Grand Central, and this one, lads, is *really* ticking. It's got a clock."

An elevator serves the squad, but no one waited. The men ran downstairs, lugging a box of bronze-colored beryllium tools. Besides O'Neil and Mulligan there were Bill Schmitt, a big, freckled, good-natured man, and Andy Sweeney, wiry, able, ex-ordnance.

IN THE police garage downstairs the special green station wagon was parked near the door. This carries equipment including a professional first-aid kit and a Geiger counter (for atom bombs). Two men went in this vehicle; two drove a plain car. They went fast.

Grand Central Terminal was throbbing with people. Firemen were already there. A block-long corridor in the great

station was a deserted tunnel of marble, closed by police who had withdrawn to safety in an alcove.

Each man now made sure he had the pocket knife sometimes needed for cutting bundles. Besides, O'Neil had a saw-edge glass knife that cuts wires without causing short circuits.

"Where is it?" O'Neil asked a policeman.

The officer led him around a corner. "Over there. Locker in top row. No. 9217, the one with the door ajar."

A traveler checking his bag had seen it first. He'd opened the door, but his bag had hit something heavy. He called to an electrician working nearby, who agreed it was a bomb, and called police.

THE four men walked rapidly down the echoing corridor. They could see a crowd forming, held back by police. Sweeney held the locker door. Each in turn peered in, using a flashlight. B Squad men never get used to bombs. Sweeney swallowed hard and said, "It's ticking."

The light showed the object hiding like a rattlesnake, under newspapers: a steel pipe seven inches long, closed with steel caps. Taped to it were a 1½-volt penlight battery and a ticking wrist watch.

Then the light showed something else. Also taped to the pipe lay a vial—a test tube—corked and filled with a clear liquid.

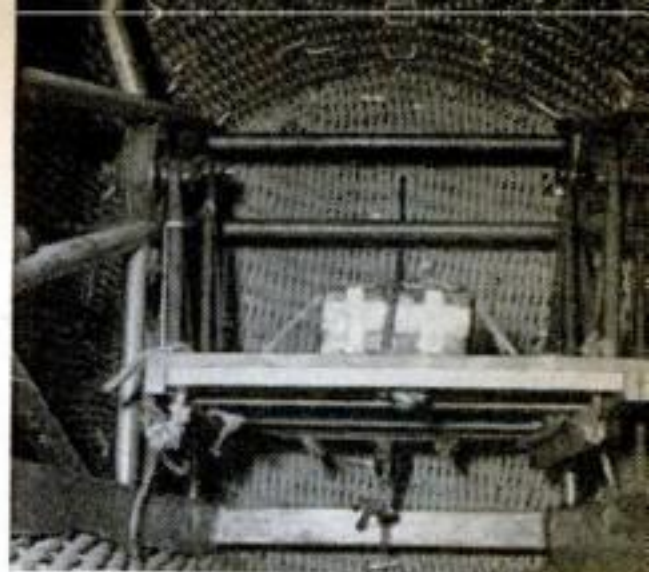
Schmitt said: "It's syrupy. Nitroglycerine?" He answered his own question: "Or it could be airplane glue or 3-in-1 oil."

The thing could be a lunatic's joke. A few minutes would tell.

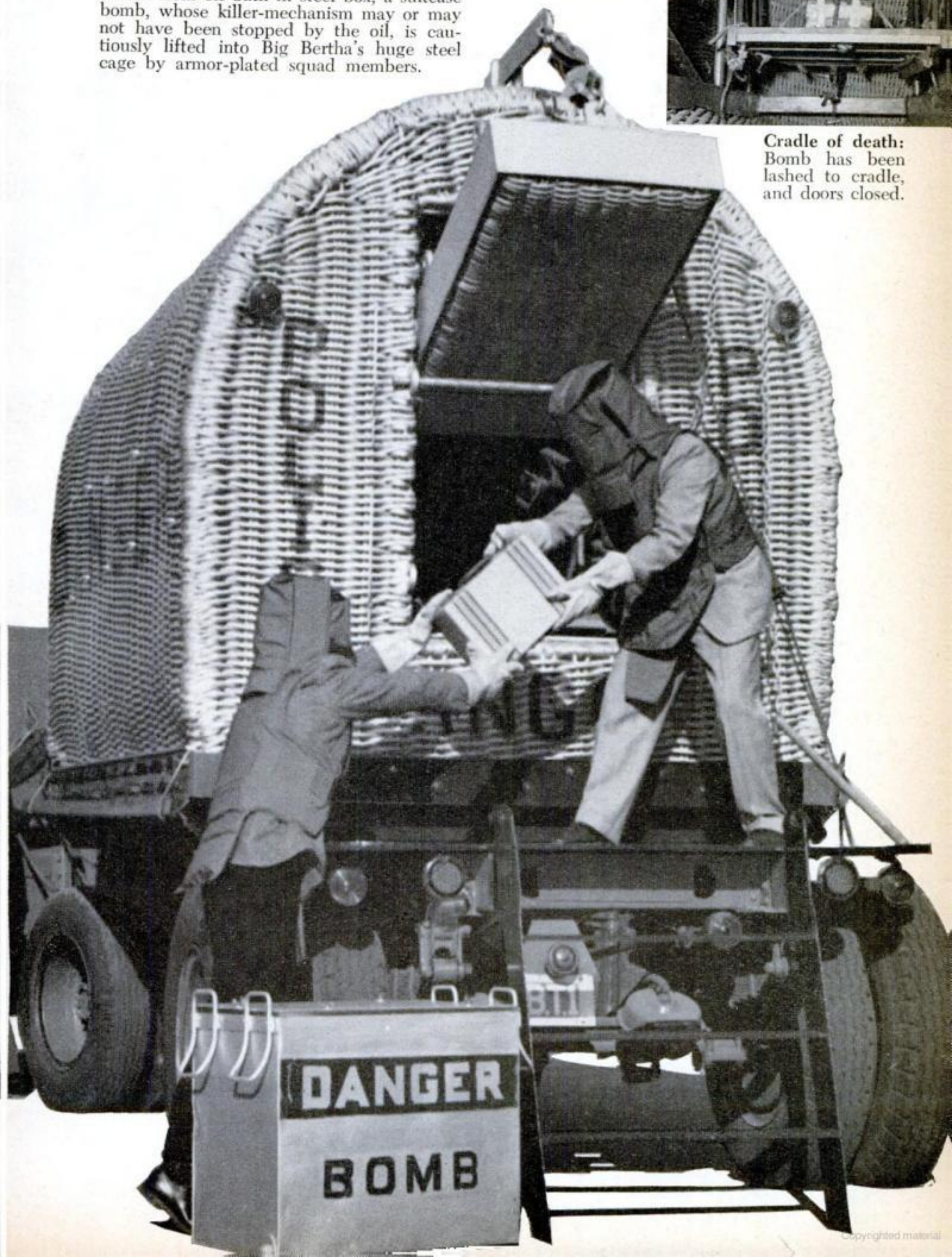


bomb aboard for a scary 10-mile trip

Lifted from oil bath in steel box, a suitcase bomb, whose killer-mechanism may or may not have been stopped by the oil, is cautiously lifted into Big Bertha's huge steel cage by armor-plated squad members.



Cradle of death:
Bomb has been
lashed to cradle,
and doors closed.



These men are risking their lives to (1) look inside a ticking infernal machine, (2) listen to its heartbeat and (3) pull it apart before time runs out



Bomb goes under fluoroscope after it has been soaked in oil and cautiously removed. Here, Detective William Schmitt is taking a quick look at bomb's time-charged inner workings.

THE four detectives left the scene. Each felt his heart beat faster. (All 14 men on the squad have wives and children.) During the brief look, each had brought every sense to bear on the object. No one had dared touch it, for some bombs are like the pattern of a madman's brain, with weird trigger mechanisms. Nearby, some girl clerks had lingered in a shop. Mulligan opened the door and said, in a think-nothing-of-it tone: "This could take us a little time. Why don't you go have some coffee?"

At 10:30 the detectives retired to the alcove. O'Neil listened while each man

gave an opinion. Two wires had been seen coming out of the pipe through a hole drilled in one cap. Through this hole, which had been cut too large, had dribbled grains of something that could be gunpowder—or harmless charcoal.

The wires led to the battery; one went from there to the watch frame and one to a small brass pin screwed through the crystal near the 11-o'clock mark. The watch had no minute hand. But its hour hand was moving inexorably toward 11.

The vial of nitroglycerine—if that was what it was—was strapped to the pipe with electrician's tape. Nitroglycerine is



Elaborate bomb dreamed up by maniac is examined at B Squad's headquarters by three of the men who took part in the Grand Central Terminal case. From left to right, Detective Bill Schmitt, Sgt. Kenneth O'Neil, and Detective Andy Sweeney.



Listening device is attached and Detective Andrew Sweeney takes over to see if clock inside bomb still ticks—meaning it may soon go off.



Sparkless "ice tongs" in hand, Schmitt again moves in to lift bomb which will be ripped apart by trucks pulling long ropes tied to the tongs.

a high explosive. It doesn't go *ga-room* like black powder, a low explosive. It whacks like the crack of doom.

TWO policemen from the Emergency Service Division, commanded by Asst. Chief Inspector Walter E. Klotzback brought in the squad's No. 1 weapon: a tank of thin motor oil into which the bomb could be lowered (if it could be moved). Oil does not affect explosives. But it can clog and stop a watch.

The men then lugged in an electronic listening device. A "mike" could be strapped to the bomb in the oil bath. Then by stringing 400 feet of wire the detectives could retire to listen through headphones until the ticking stopped—if it did.

Other tools brought were X-ray, fluoroscope, and radiophotography gear for looking inside the thing after it had been lifted from locker 9217.

Also on hand were beryllium tri-tongs. These are like ice tongs attached to long ropes. Some bombs can be placed between the tongs and the ropes gently pulled to set the claws. Then the ropes are run to trucks and the bomb torn apart to destroy its wiring.

But tri-tongs work only on packages. And, as it turned out, none of this equip-

ment (or the Geiger counter) ever got to be used. For everybody was afraid to lift this bomb into the oil bath. And so it went on ticking.

Some bombs are moved after being "teased"—jerked around with long ropes to make sure they won't go off when moved. (Some contain hidden hair triggers.) But a great railway terminal is no place for bomb-teasing. Besides, the time was nearing 11.

The squad now faced its moment of truth. Somehow the infernal thing had to be gotten out of the station. There was no way to carry the locker bodily; it was part of a huge unit. They would have to take a win-or-lose gamble and attack the thing with surgery.

As a last resort, in such cases, the men put on armor. This they don't like because concussion can squeeze a man to death between the steel breast-and-back plates. They did not, however, wear their armored gauntlets. Handling the bomb would call for every bit of touch sense. Also, they would be handicapped enough trying to see it through steel eye slits.

Before O'Neil climbed into his suit he had gone back to the alcove. "Have them start Big Bertha on its way," he ordered. Then he asked firemen to have hoses and foam ready.

OUT on Randall's Island, two miles away in the East River, there was a sudden noise like Sherman tanks in action. A garage door raised, and a nightmare rolled out and roared toward Manhattan. This was Big Bertha, a monstrous 15-ton semitrailer truck few New Yorkers have ever seen. The tractor is an ordinary GM unit. But the trailer is a sight to frighten.

It is a great, woven, other-worldish round cage 12 feet high—a sort of hangar. It is woven of shining, aluminum-painted steel cable, the same stuff used in blasting mats. Someone once set off 24 sticks of dynamite in this awesome vehicle. Big Bertha vanished for an instant in red flame but the only thing that came through the net walls was fire. In case of explosion en route, the driver is shielded by a wall of inch-thick steel.

This bomb cage, preceded by motorcycles, came booming down Roosevelt Drive, scaring the wits out of motorists.

At 10:48, O'Neil rejoined his three detectives at locker 9217. The little watch was still ticking.

THE beryllium tool kit now was moved close. With top open, it could be seen to contain a craftsman's dream: glittering pliers, saws that seemed to be made of gold, wire-cutting "diagonals," screwdrivers, wrenches of all sizes, crow-bars, even small shovels. Why beryllium? To avoid sparks.

O'Neil planned three first moves: (1) cut wires; (2) remove watch; (3) unbind vial from pipe, a highly dangerous step—for the smallest shock, even hand heat, can set off nitroglycerine. The locker door kept trying to close. Mulligan held it open. O'Neil focused a big wet-cell light on the object. Sweeney reached in—it lay at arm's length—and did his best to anchor it while big Bill Schmitt, fingers tense, probed cautiously with the diagonals.

This was the moment. Schmitt found the wires, got them in the jaw, and squeezed. His hands shook; no one knew what was at the *other* end of those wires, inside the pipe. The blades bit the wires,

then clicked together with an audible snap. The wires were cut and nothing had happened.

But bomb makers, crazy with hate, load their brain-children with booby traps. Schmitt gingerly withdrew the cutters, passed them to O'Neil, and reached barehanded for the watch. He grasped the thing, handed it, too, to O'Neil, who took it down the corridor to an officer who rushed it to the Crime Lab, still ticking, for study. Schmitt also handed out the battery.

So far, so good. But now there were wires linking vial and pipe (and possibly a hidden blasting cap). Sweeney felt for the vial, pressed down on it using only his fingertips, to keep the hand's heat away. Again Schmitt reached out with the cutter. Outside, there was a roar. Big Bertha was arriving.

Schmitt's cutters found one wire and snipped it. Then the second wire. He took a breath and, perspiring, lifted the vial barely an inch. He now had all their lives in his hand. To tip the vial might close a switch or release acid and all would be over—if this were really nitroglycerine. He held the vial level, in its original posture, and with infinite pains drew it toward him.

A patrolman held a small cardboard box lined with cotton. No baby in a cradle was ever put to bed with more loving care. Schmitt put the vial down in the cotton. Then Sweeney took the box.

TO GET to Big Bertha, rumbling in the alley, he had to go through a shop. He made it safely, carrying the "cradle" perfectly level, almost tiptoeing. Two Emergency men—the truck's crew—were waiting in armor. They unbarred the clanking rear gate, hoisted it heavily with block and tackle, took the cradle, and gently lowered it between two boards in a special wooden sled.

Sweeney went into the truck with them, saw the vial lashed firmly to the grid. Then all withdrew, and the door was closed and barred. With another

[Continued on page 188]

Jeep Gets Overhead- Cam Engine

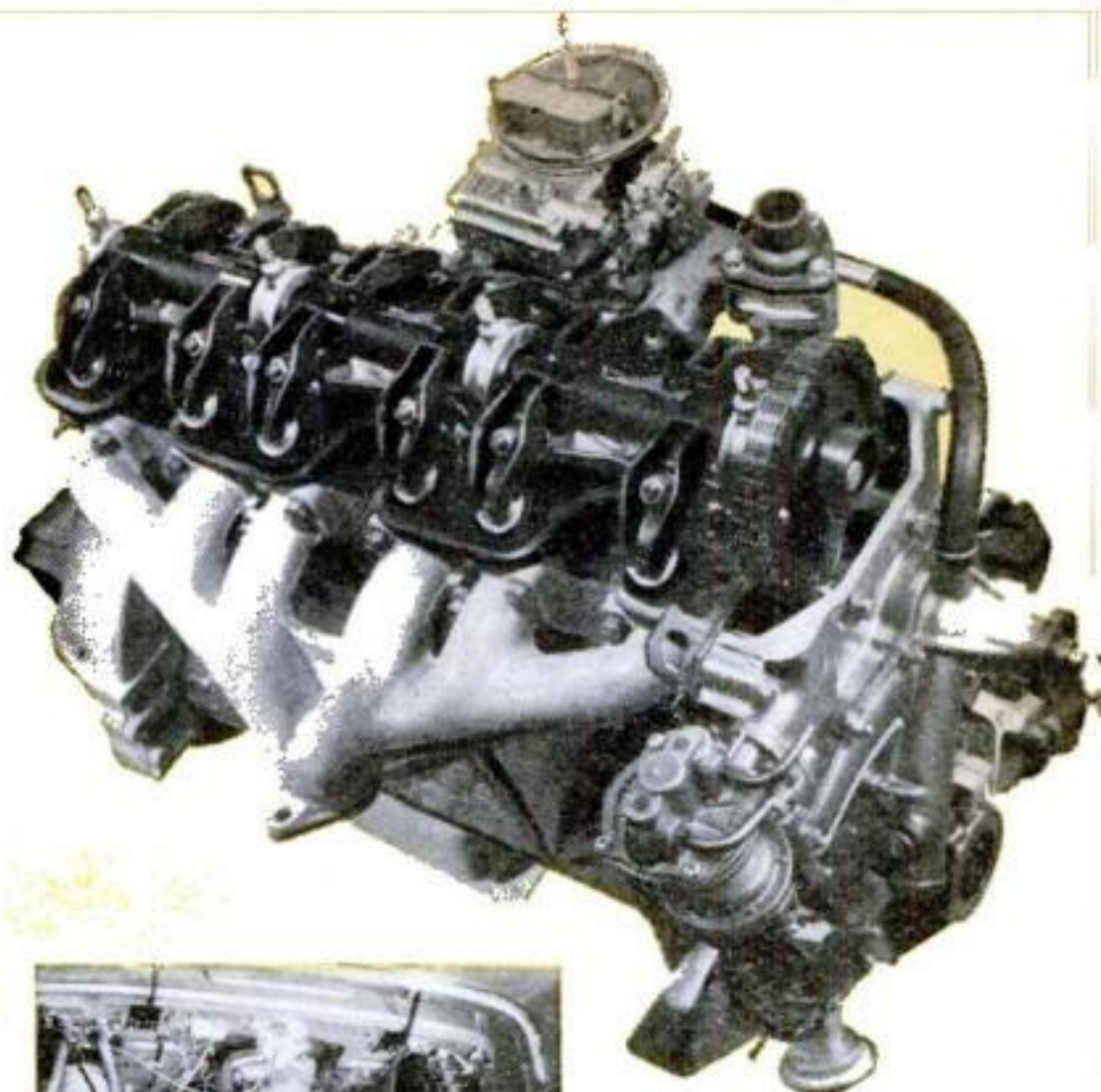
OVERHEAD-CAMSHAFT engines—traditionally free-breathing, hot performers—have a glamorous past. Such famous old-timers as Stutz, Wills Sainte Claire, and Duesenberg once rolled under OHC power. The most recent in this country was the Crosley.

Now Willys has come out with a new OHC, optional on most of its Jeep line. Designated the Tornado-OHC, it is a small but powerful heavy-duty engine. A 230-cube in-line six, it puts out 140 hp. at 4,000 r.p.m.—a conservative rating according to the factory. Torque is 210 lb.-ft. at only 1,750 r.p.m. Low-speed power, of course, is desirable in commercial vehicles. Bore and stroke are 3.34 and 4.38 inches respectively. Compression ratio is 8.5:1.

The OHC design eliminates much of the conventional valve train, including push rods, tappets, and followers. Both the intake and exhaust valves for each cylinder are activated by a single cam lobe. The camshaft is driven by an internally toothed chain.

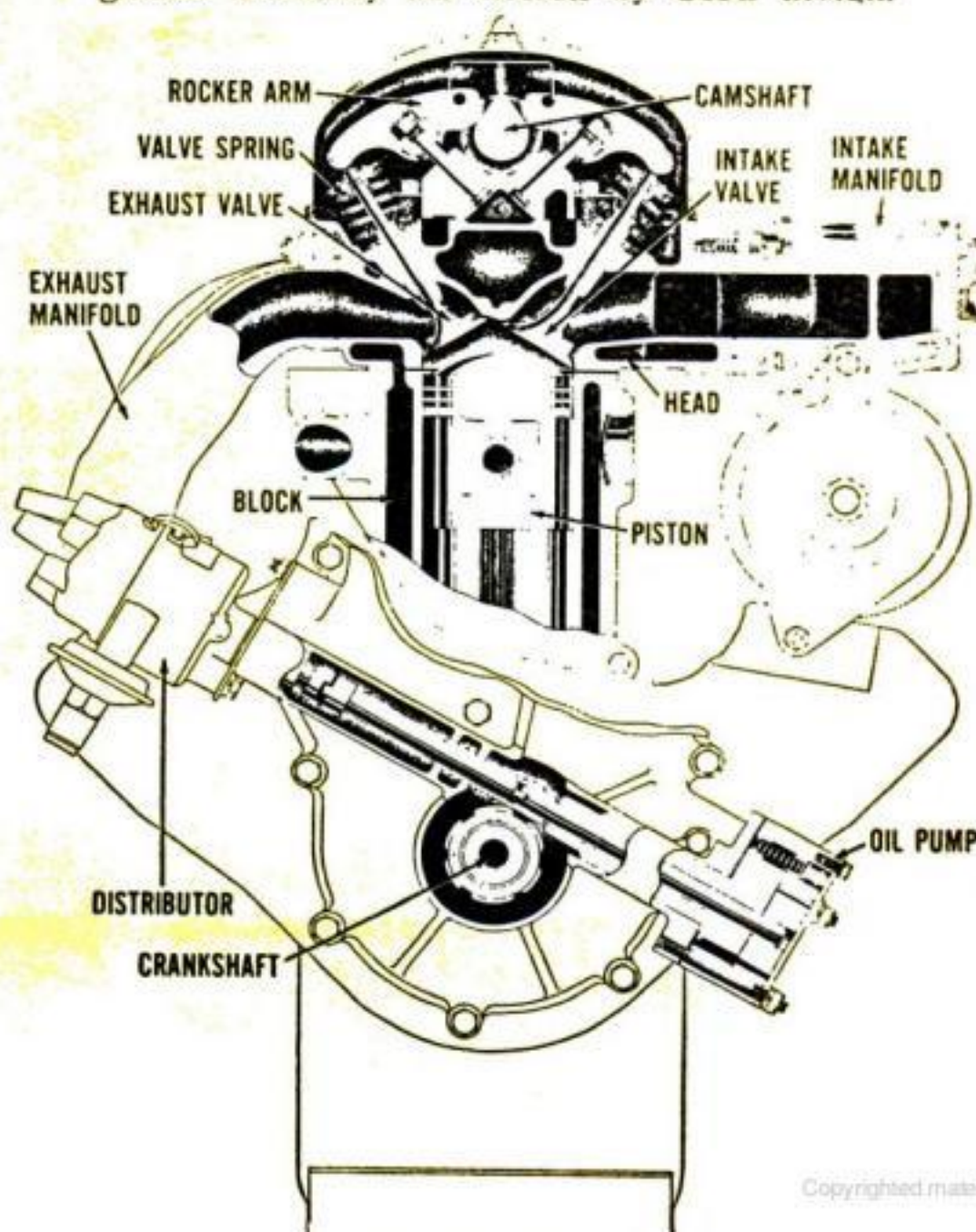
Conventional Jeep engines have never been noted for fuel economy. The OHC, however, has an unusual spheroidal combustion chamber that permits the use of large valves and provides controlled turbulence. Domed pistons also increase efficiency. This adds up to improved mileage on regular gas.

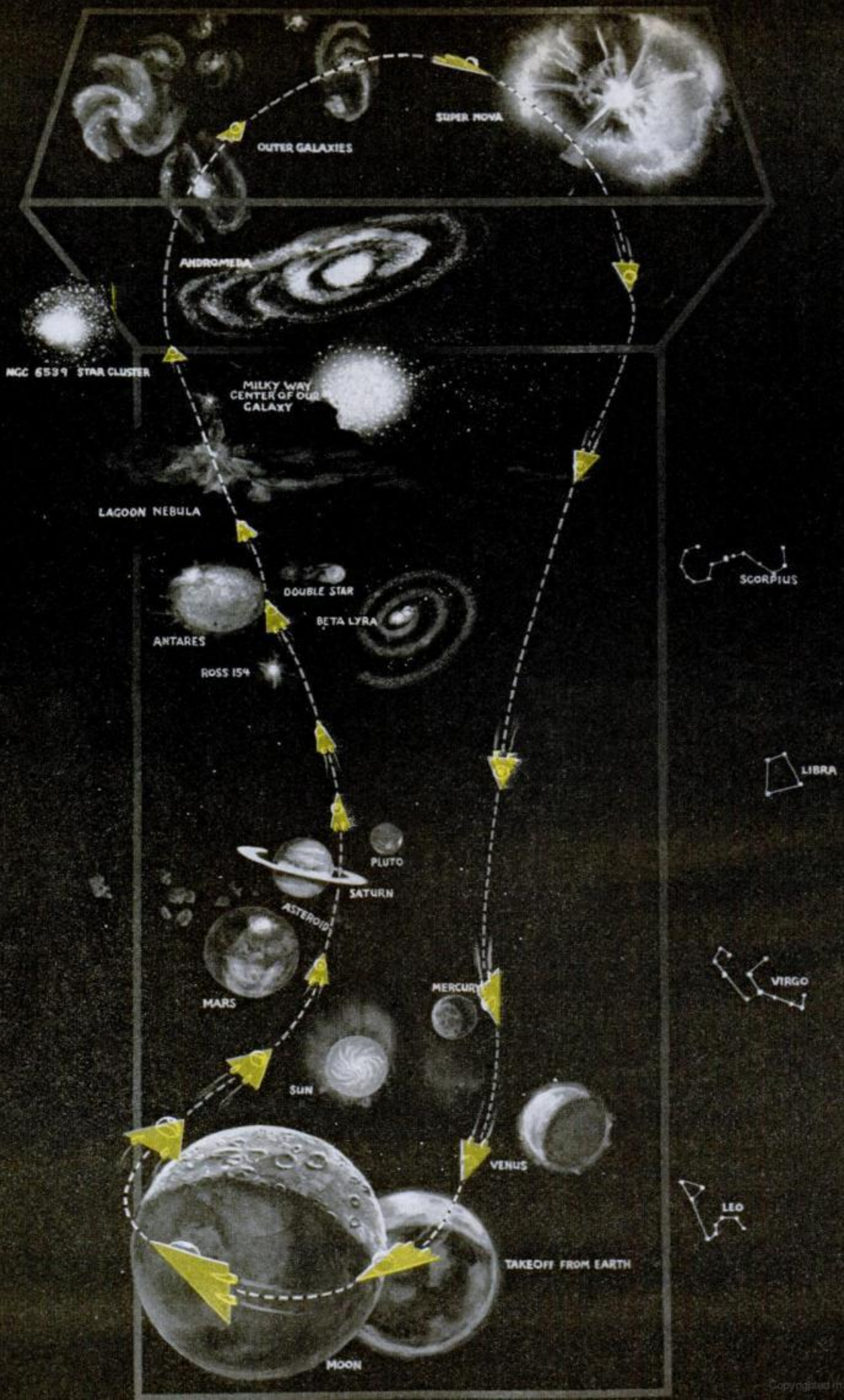
Developed by Willys, the engine is available in five Jeep models: the four-wheel-drive utility wagon, one-ton pickup truck and panel delivery, and the two-wheel-drive station wagon and sedan delivery. You can't get it on the small Universal models now powered by the F-head four.—*Alex Markovich.*



Removal of rocker-arm cover bares entire valve train. Complete head assembly can be removed by disconnecting a few small accessories. Engine fits compactly, but isn't crowded.

Rugged six has four main bearings, specially hardened crank. Each cam lobe tickles both intake and exhaust valves. Better breathing, greater efficiency are offered by OHC design.





Seattle Fair's remarkable
movie takes you

Around Outer Space in 12 Minutes

ONE of the most remarkable experiences of a visit to the Seattle World's Fair is a trip of a billion billion miles through space.

The "trip" consists of watching a 12-minute color movie called *Journey to the Stars*. It is projected on the inside of a forward-tilted, 8-ton dome of aluminum, 78 feet in diameter and 38 feet high. The movie takes its standing audience on an imaginary, but vividly realistic, spaceship flight through our own solar system and two billion light years beyond. It is the feature attraction of the Fair's Spacearium, sponsored by the U. S. Government and the Boeing Company.

The movie, a triumph of stop-motion animated photography, is a sequence of 22,000 separate frames, which took a year to stage and film. For example, the nine minutes of projection time devoted to exploring our moon, sun, and neighbor planets required 4½ months of preparation and three months of shooting.

A spaceship would have to travel a trillion times faster than light to cover as much celestial territory as the space movie covers in 12 minutes. Yet most of the film was made in an area smaller than the average bedroom.

The accompanying photos were taken while Fine Arts Productions of Hollywood was making *Journey to the Stars*.



It's a small universe when planets are this size and placed so close together. Yet the magic of photo lighting, an inverted telephoto lens, and stop-motion photography made it seem properly huge.



Dome of heaven under which much of movie was filmed was ⅝-inch fiber-glass. Exact positions of 1,600 brightest stars were plotted on it with aid of star charts. Then holes of proper scale for each star, down to 1/64 inch, were drilled through the dome.



Spacearium's 78-foot-wide screen, made of 3,600 aluminum triangles, is shown, in cutaway drawing, suspended inside the Science Pavilion at the World's Fair. Special projector is mounted in center of a tiered floor. The audience watches from behind railings.

Road map for a space journey: Chart at left shows the route traveled by "passengers" at the Spacearium. The film takes you two billion light years away from Earth to the Milky Way and beyond.



The Back-Seat Driver of the B-58

When trouble brews on SAC's fastest bomber, the recorded voice of pretty Gina Drazin (shown at right) alerts its crew



By Wesley S. Griswold

ONE fine day in 1955, Ray Tenhoff, then a test pilot, nearly flew a Northrop F-89 Jet into the ground.

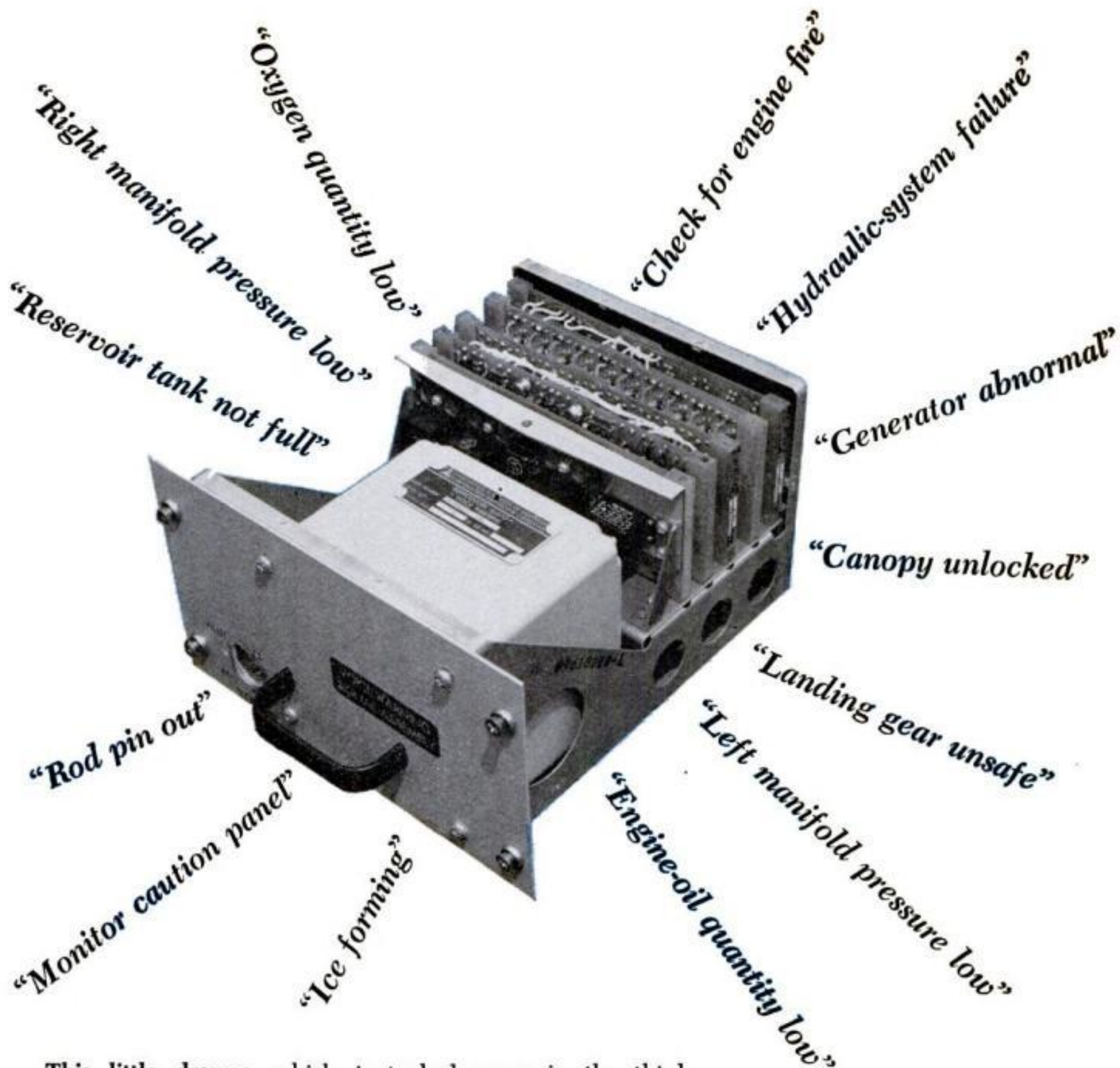
He had been trying out the plane's radar equipment. Momentarily, he was blinded by what is called "screen fixation." In seconds, he was flying straight down instead of level.

He had a close call. Tall, handsome Tenhoff, normally as calm as a stone, was shaken by his experience.

"You guys," he later protested to Al

Vogel, a Northrop engineer, "ought to rig up something that would warn pilots *vocally* when they're getting into trouble. Remember, they can't always depend on their eyes."

Vogel thought it a fine idea. He led a team that transformed the suggestion into an eight-pound electronic package. It caught the interest of the Air Force. Today the Voice Warning System, an important new aid to flying safety, is being installed in every one of SAC's fastest bombers, the B-58 Hustlers. One pilot has called it "the greatest thing since canned beer."



This little drawer, which is tucked away in the third crewman's cockpit in a B-58, contains the heart of the Voice Warning System. In front is the box containing tape player and amplifiers. Behind are the memory and logic circuits.

The Voice Warning System not only tells a pilot when something's going haywire on his plane, but often tells him what to do about it. More important, it speaks with a woman's voice.

Tests have proved that by this startling means the pilot gets the message four times faster than he ever did before. Furthermore, with typical feminine persistence, the VWS keeps telling the pilot what's wrong until he corrects it.

Airplanes have long had a basic alarm system for notifying pilots when trouble is brewing. The system is triggered by

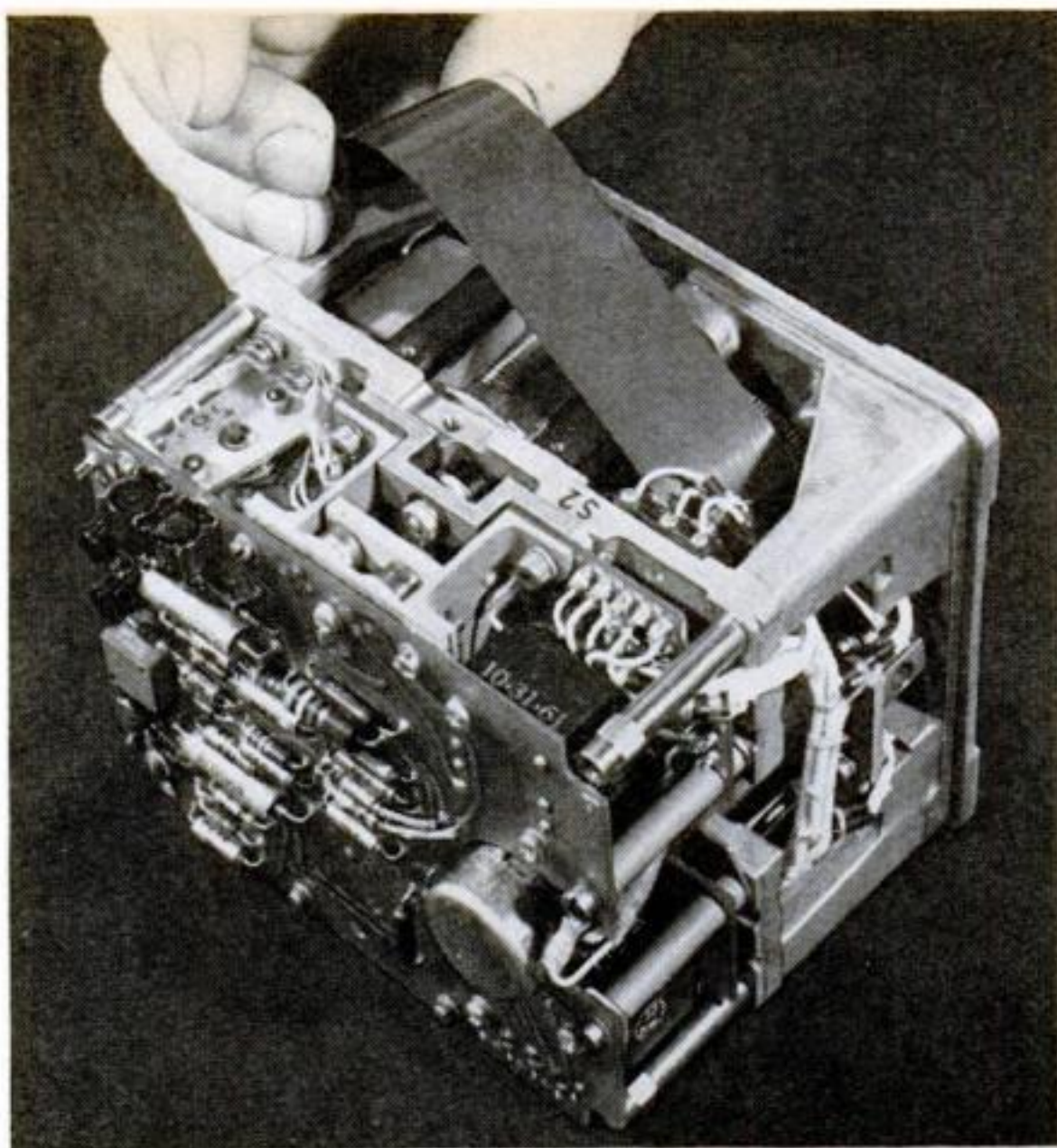
fault switches. These are like sensitive nerve ends in the intricate network of fuel, hydraulic, and electrical lines that keeps a plane flying. If something happens in one of these lines that shouldn't, or something fails to happen that should, a fault switch signals in the pilot's cockpit. The signal may sound a buzzer, bell, horn, or bongo drum. These alarms can be smothered or misinterpreted. In most cases, however, a warning light flashes on behind a small panel sign that spells out the source of the trouble.

Unfortunately, these little lighted signs are often not seen soon enough. In

Test pilot's idea came too late to save his life



Narrow escape from death in 1955 inspired Ray Tenhoff (above), then a test pilot, to suggest a vocal warning system for jets. He died in a crash before it was perfected.



Vocal warnings of 50 faults that could develop aboard a four-jet Hustler bomber in flight are recorded on magnetic tape, shown in man's hand. Tape is 50 inches long, inch wide.

supersonic planes, trouble can develop at breakneck speed.

Incredible as it seems, in one Air Force test a B-58 pilot failed to notice a cockpit warning light for 39 minutes after it appeared. And even the sharpest pilots usually took 12 seconds to see a lighted panel sign, grasp its message, and react properly.

An astonishing improvement occurred at once when the Voice Warning System was tried out. Pilots responded correctly in three seconds, on the average. Not one warning was ignored.

The Air Force felt there was no better place for the VWS to start work than in the 1,400-m.p.h. B-58 [PS, Aug. '61].

The Voice Warning System is tied into the B-58's fault-switch network. Any fault that lights a sign on the pilot's warning panel makes the VWS sound off, too. As an extra precaution, the Air Force will use both alarm systems simultaneously.

The VWS tells its troubles to pilot

and crew through their headsets. If these men are listening to a tower operator or the pilot of another plane at the time, or talking among themselves, the VWS cuts right in and drowns out all other sounds.

Why use a woman's voice? Because chatter on military radios is usually male, and thus tends to become routine. The listener's attention may wander. The sudden sound of a woman's cool tones in an air crew's headphones, however, is bound to make them sit up and take notice.

The voice chosen belongs to a trim brunette, Mrs. Gina Drazin. She's a strikingly attractive Northrop secretary, with gray-blue eyes and a touch of auburn in her dark hair. Her recorded voice, however, is something else again.

Its prime quality is clarity—flat, clean, slow enunciation, carefully drained of all charm and emotion. When this voice says, "Check for engine fire," it sounds

[Continued on page 178]



Army parachutist scores a bull's-eye

A dead-center landing on a cloth cross is made above at El Centro, Calif., by a member of the U.S. Army Parachute Team.

The Army team captured the unofficial world parachute title at an international meet in France last summer, and so far this year has set 18 records. An official world meet will be held next month at Orange, Mass.



Telephone designed for hard-of-hearing

A new telephone handset has a switch on the arm between the receiver and mouthpiece to adjust the loudness of incoming calls.

Bell developed the volume-control device for use by people with impaired hearing. The new receiver can be installed on any telephone model now in use.



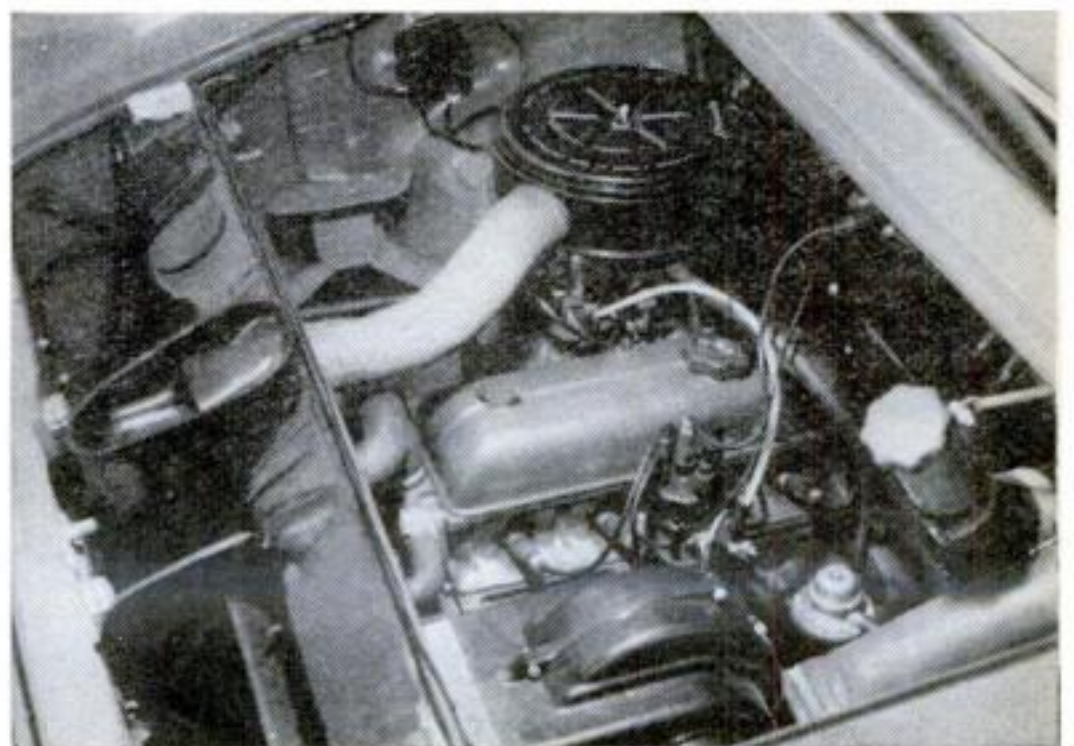
Caravelle S offers more performance

Over 27 percent more power plus other refinements make the Renault Caravelle S an all-new car—though outwardly it resembles the earlier Caravelle.

The four-cylinder rear engine gets 51 hp. from 58.34 cu. in. (the old 51.57-incher put out 40 hp.). Stroke is reduced for higher r.p.m., and five main bearings support the crank. Top speed: over 85.

Disk brakes all around give more stopping power. The sealed cooling system needs no maintenance. Suspension is reworked for better handling, and steering is faster. The rear window is bigger.

The car seats four and also comes in convertible form. A detachable hardtop is available.





Showing off its topside engines, Helio Twin makes a turn at 187-m.p.h. top speed. Reverse

tricycle landing gear and forward placement of main wheels prevent nose-over on rough fields.

Twin engines ride high on wings of steep-climbing plane

Any cow pasture is an airfield for the new Helio 500 Twin STOL (short takeoff and landing) airplane. For takeoff, 320 feet will do; landing roll is less than 300 feet. High forward position of the engines pro-

tections them from damage by dust and debris thrown up when operating from rough fields.

The 500 is fully maneuverable at 36 m.p.h. (a speed at which most planes of its kind would stall), and it will fly slowly



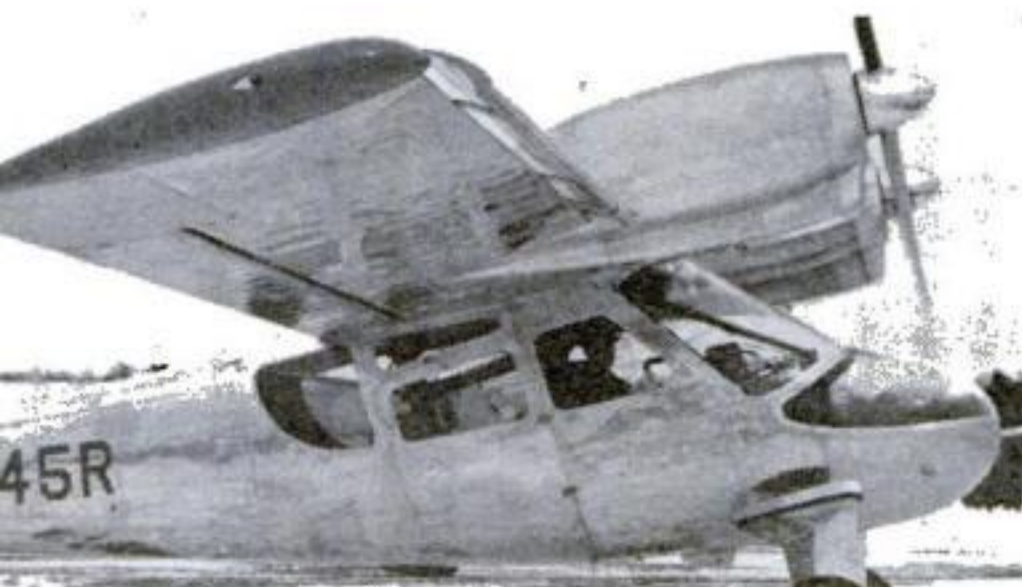
Scout car has low floor

A transversely mounted 58-cubic-inch engine drives the front wheels of this British scout car, leaving a flat floor with plenty of leg room for four people. The chassis is from an Austin 850 with rubber suspension.

Instead of a supporting frame, the body is strengthened by boxlike sills that serve as storage lockers. The car, still experimental, is intended for military use.



Flying at 49 m.p.h., this Twin broke ground after a run of 250 feet. Its high-lift flaps are shown extended 64 percent. With a full load, the plane can climb 1,600 feet a minute.



Automatic slats on leading edge of wings enable the Helio 500 to fly and maneuver at speeds as low as 36 m.p.h. The plane's wing span is 41 feet; overall length is 35 feet.

under bad weather, scouting out flat areas for emergency landing. Two 250-hp. Lycoming engines give it an 800-mile range.

A follow-up of the single-engine Helio Courier [PS, Mar. '56], the six-place Twin is made by Helio Aircraft Corp., Norwood,



Throttle quadrant and prop-feathering levers are located overhead. Other cockpit instruments and controls are standard. Wide Plexiglas areas give the pilot all-around vision.

Mass. The first two prototypes will be evaluated by the Air Force for use as a utility plane in rugged areas, such as Vietnam, where helicopters are now the only practicable aircraft. Civilian production is scheduled for later this year.

Aluminum bus shines in London

A new unpainted aluminum bus is being tested on London streets.

Transit authorities there want to see how the "White Lady," as the bus drivers have christened it, compares in wear, appearance, and maintenance costs with the old familiar red-painted double-decker beside it in the photo.



"I Say It Pays to Run a Car 100,000 Miles!"

The author's '56 Chevy has gone well past that mark and it's still going strong. Here's how he did it and how much it cost

Year	Miles Driven	Gas and Oil	M. P. G.	Insurance and Taxes	Maintenance and Repair	Cost Per Mile Maintenance and Repair (cents)	Purchase Price of Car	Cost Per Mile Total (cents)
1956*	8,071	\$167	**	\$156.50	\$120	1.486	\$1,755	27.239
1957	12,600	229	**	234.50	201	1.595	—	5.274
1958	17,766	277	17.9	199.50†	253	1.424	—	4.106
1959	22,078	367	18.2	199.50	420	1.902	—	4.468
1960	20,541	343	18.8	206.50	306	1.490	—	4.165
1961	16,226	275	19.5	158.50††	194	1.195	—	3.867
1962##	2,720	49	19.1	=	33	1.213	—	3.015
Totals	100,002	\$1,707	*	\$1,155.00	\$1,527	1.527	\$1,755	6.144

*Six months (July through December); **Not available; †Decrease because of change of residence; ††Discontinued collision insurance (not economical for old car); #Paid through June, 1962 (included in 1961 figure); ==Two months (January and February).



Car is maintained in like-new condition by author. Lack of garaging necessitated a \$150 paint job in 1959. Pair of mirrors on fenders are convex or diminishing type, affording a wide angle of rear vision.



Uneven tire wear indicates out-of-line wheels. Author has the wheels balanced every 15,000 miles and checks alignment whenever shimmies develop. His tires last nearly 40,000 miles.

By Robert Marx

I WATCHED hypnotically as the mileage indicator crept from 99999.9 to 00000.0. The engine was purring smoothly. No shimmy, rattles, or expensive noises.

The trusty old '56 Chevy seemed eager to start its second 100,000 miles. Gas mileage was running well over 18 m.p.g. Oil consumption averaged one quart every 500 miles.

In the five years and eight months that I'd had the car, it cost me \$6,144, or a hair over six cents a mile. This includes purchase price, gas, oil, insurance, repairs, and one paint job. Who says it doesn't pay to keep a car longer than three years?



My 100,000-mile adventure began in 1956. I had just sold my Jaguar and was looking for a sturdy, reasonably economical car requiring a minimum of maintenance. My experiences with the Jag also convinced me that widespread service facilities were important. The 1500-series Chevy six-cylinder model, stripped except for heater, seemed the best buy then at \$1,755.

I kept the car in good mechanical condition, but didn't baby it. It wasn't garaged. It ran on the cheapest gas available, and used medium-grade oil, with an occasional dose of detergent premium. I got tune-ups only when performance dropped noticeably.

When I first started keeping records of my car expenses, it wasn't with the idea of proving anything. It was strictly for my own information. But the figures do show that it paid to keep my car as long as I have. Amazingly, repair and maintenance costs per mile were a fraction of a

penny *lower* after the first 20,000 miles than before.

Things weren't always rosy. Like that disastrous trip from upstate, which was beset by mechanical troubles.

First came an elusive breakdown in the ignition system that caused a rough engine throughout the trip. A real Gus story. I had limped into two service stations and had the distributor and plugs cleaned, but the trouble persisted. I barely made it to the third station with the engine on the verge of dying.

The plugs were okay, but the distributor was filled with dust. I explained to the mechanic that this was impossible: The distributor had just been cleaned two days ago.

The mechanic took a dab of the dust on his finger; it was metal shavings. The mystery was solved when he took the distributor apart. A screw holding one of the centrifugal flyweights had broken, and the rotating weight had milled a



Seat belts provide extra measure of protection; author won't drive a block without fastening his. Good driving habits, he says, result in greater economy as well as safety.

neat groove in the metal housing of the distributor. As the metal powder accumulated, it caused a progressively rougher engine.

Another breakdown. A few hours later, as I was doing about 60, I suddenly heard a grinding, crunching noise. It seemed to come from all around me. At the nearest garage, I got the bad news: A transmission gear had disintegrated because of oil starvation. A tiny hole that controlled oil flow to the gear had gummed up. The repair bill: \$86.

At this point I began to wonder whether it wasn't time to get a new car. But I fought down the temptation and decided to give my car another chance.

Since then, there have been no major breakdowns. Altogether, since I've had the car, I've replaced the following parts: two sets of tires, \$165; battery (after five years and 97,000 miles), \$24.90; fuel pump, \$9.65; rebuilt carburetor, \$10; new carburetor, \$26; distributor, \$14.78; rear-axle bearing and seal, \$20; engine oil seal, \$30; front brake linings, including turning down the drums, (at 3,863 miles), \$19.10; rear

brake shoes (oil had gotten on them somehow at 62,530 miles), \$3.40.

"An independent attitude." What are the secrets of running a car economically? One is the ability to withstand high-pressure salesmanship. For example, I didn't replace my plugs every time a mechanic recommended it. With cleaning and adjustment they were often good for another 5,000 miles.

When steering became wobbly one day, I took the car to a garage for an alignment check. By the time my turn came to speak to the service manager, a mechanic had already removed both front wheels down to the bare axles. He announced that the car needed front-end repairs worth \$95. With the car half disassembled on a rack, I needed an independent attitude to get it back without ordering the "necessary" repairs. At another garage the shimmy was corrected for \$3.75. That was 68,000 miles ago, and I still haven't had to spend that \$95.

How often should oil be changed? This perennial question probably will never be answered with certainty; driving conditions vary too much. Not having an oil filter, I decided on a 1,500-mile interval.

When a part failed, I first found out whether it paid to repair it. If not, a rebuilt part often was available. My rebuilt carburetor, for example, was good for 63,000 miles while the original one gave trouble after 10,000. I always bought quality, name-brand replacement parts.

How long will I keep the car? Since the 100,000-mile mark, I've replaced a defective front-wheel bearing for \$5.50 and a worn A-frame bushing for \$18. A thorough check turned up a bit of rust on one of the doors, a slight increase in oil consumption—and nothing else.

With trade-in value almost nil and insurance costs at a minimum, it will pay me to keep the car as long as it runs smoothly and no major breakdowns occur—even if it costs me a few hundred dollars a year for repairs. ■ ■

How Old Is It?

Whether it's a tree, a human skull, a Stone Age tool, or the Earth itself, scientists are rapidly finding ways to determine the age of almost anything



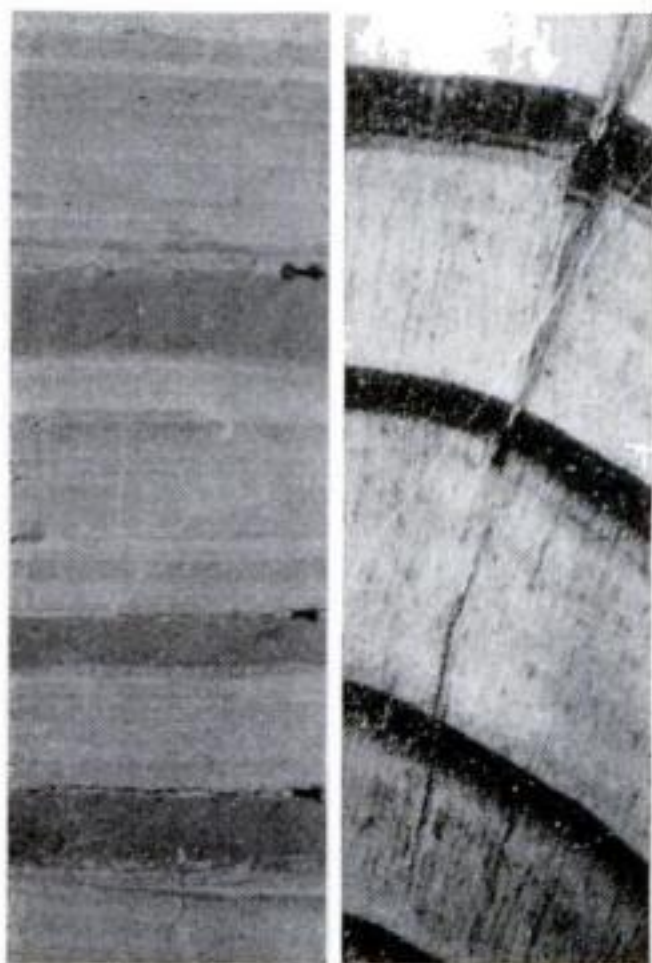
Devil's Tower, 865 feet of once-molten lava, has stood for 4½ million years. *Photo: Amer. Mus. of Natural History.*

By Robert Gannon

TWO miles south of the Arctic Circle in Alaska, an anthropologist steps into the remains of an ancient Eskimo shelter. Kneeling, he scoops charcoal fragments from a fire extinguished some 45 centuries ago. Analyzed and dated, the carbon will pinpoint one of man's first crossings over the Bering Strait land bridge into the new world.

At a California university, a scientist drops a piece of meteorite into a crucible to heat it to 2,200 degrees. The specimen begins to melt. Soon tests of elements in it will help put a date on the birth of our solar system.

Not long ago these dating techniques were unknown. Today, with geochronologists chipping away fancy mud packs and throwing light on wrinkles, the past can no longer hide its age.



Varve deposits (far left)—clay in winter, light sand in summer—tell history of Pleistocene lake bed. Tree rings (near left) gave age of a 158-year-old pine tree.

CONTINUED



Prehistoric tree stump was exposed by low tide on New England coast 30 feet below crest of high tide. Prof. John Lyon of Dartmouth College established how fast sea is rising over the years by making carbon-14 tests of wood chips from such stumps.

Dating ancient things used to be as tough as counting births in China. It was largely a matter of *counting* back. Two old methods are still in use:

- Tree rings, although as handy as an abacus, let you count back only a thousand years or so. Annual rings in a tree growing through ruins of a Greek house showed that the tree had been there about 1,200 years. But how long had the ruins been there before the seedling took root?

- Varve deposits—annual layers of silt laid down by melting snow in spring—are as good as candles on a cake. An axe head dug from such deposits was dated by counting the varves on it. But how can you be sure that deposits were made every year?

The old methods were hardly foolproof and they stop short of what we want to know—something a lot more hoary—the age of the Earth itself.

First to issue a birth certificate was the Irish Archbishop James Usher. About mid-1600, he settled down with a Bible and spent four years adding up genera-

tions. His conclusion: The Earth was created on Oct. 26, 4004 B.C., at nine a.m.

Not everyone was satisfied with this count. When fossils were recognized for what they are—petrified remains of ancient plants or animals—labeling them only a few thousands years old seemed incredible. To figure their age, early geologists tried employing logic. The answers were wild, but they all indicated one thing: The archbishop was way out in left field.

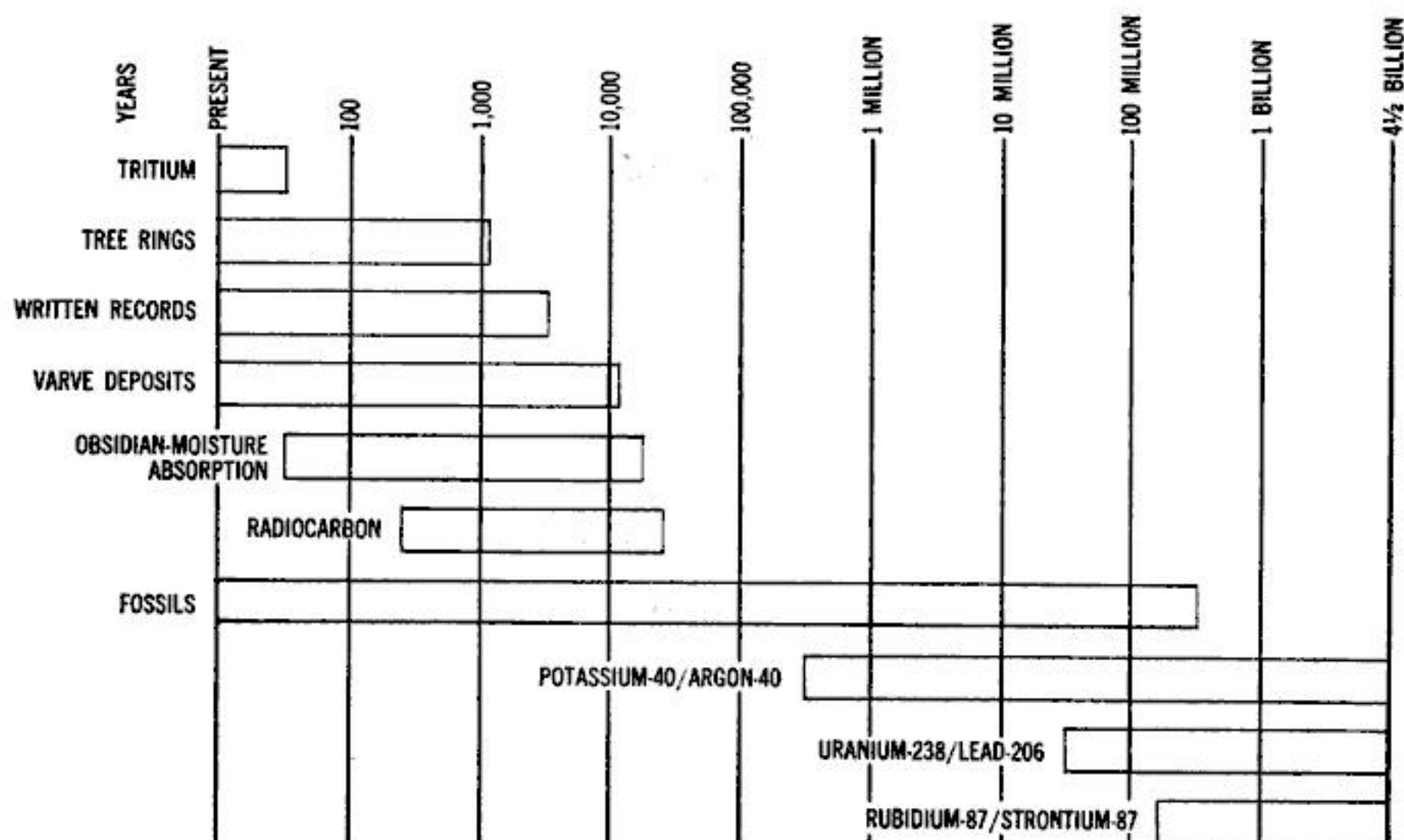
The big breakthrough. In 1896, one of those laboratory accidents occurred that occasionally sets the scientific world on its ear. The French physicist Becquerel tossed a few hunks of uranium ore into a drawer on top of photographic plates. When he developed the plates a week later, he found them splotched and darkened. A mysterious radiation from the uranium had exposed them.

Soon after, scientists nailed down just what radiation is: the breakdown of unstable radioactive isotopes into stable forms at a fixed rate. They saw that uranium and many other radioactive min-



Recorded age of Egyptian boat at Chicago Natural History Museum—3,750 years. C-14 test matched it.

How geochronologists do short-term figuring or count back to earliest eras



Counting backward can be the staggering requirement for pinning a birth certificate on the

Earth, or proving the age of a 100-year-old antique. But there's a method of dating each.

erals eventually turn to lead. If they knew how long the change-over took, the ratio of lead to radioactive substances would tell them the age of the mineral.

Now, uranium-238 has a half-life of 4½ billion years (half of it's gone after that many years, with only half the *remainder* still around after another 4½ billion years, and so on). If researchers find that a piece of rock contains exactly three parts of U-238 to one of "radiogenic" lead, then the rock hunk must be about 2¼-billion years old, measured from the time it cooled from the molten state.

But uranium comes in more than one form; it doesn't decay straightaway into lead, and thorium and actinium—often mixed in—also decay to lead.

By the time scientists had figured out just which element was doing what and how fast, atomic research had switched from Earth history to Earth destruction. World War II had started. After the war, geochemists isolated various "parent" and "daughter" elements, pinpointed the different half-lives, specified their properties, and put the knowledge to work.

The strange habits of isotopes. To uncover long-held secrets of the Earth, scientists took advantage of the isotopic transformation of uranium to lead, rubidium to strontium, potassium to argon. Under good conditions, any of the three can give dates with accuracy within five percent. All work pretty much alike. Here's how one pinned a birthday on a national monument:

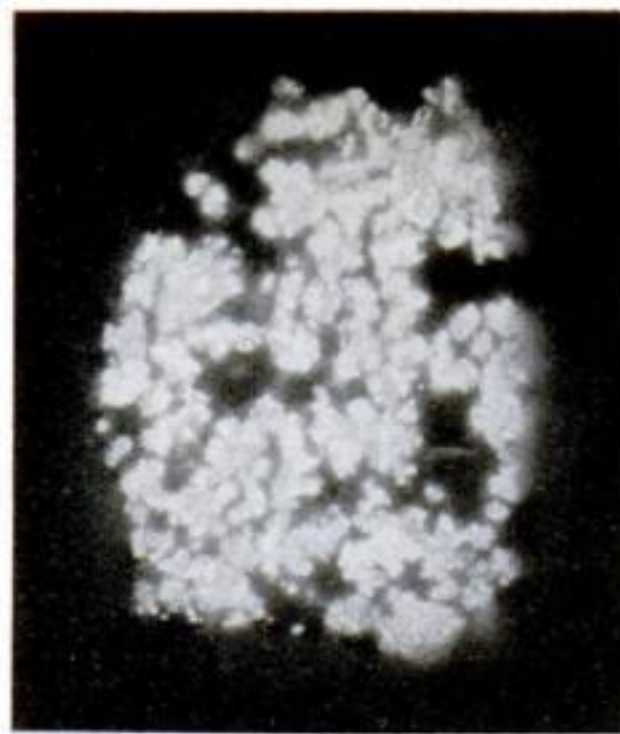
Sometime during the Tertiary geologic period, a volcano erupted in Wyoming. Over the years, the lava cooled, forming a rock plug or "neck" in the volcano. Gradually, through centuries, the surrounding soft stone eroded. Today, only the plug—the Devil's Tower—stands majestically, 865 feet above the plain.

How old is it? To find out, geochronologist William A. Basset of the Brookhaven National Laboratory ran a chunk of it through a potassium-argon test.

Before the volcano erupted violently, any argon-40 formed in the bubbling lava would have boiled away. Once cooled, however, the resulting volcanic rock imprisoned nearly every argon-40 atom gen-



Uranium ore in the hunk of rock at left shows up to the naked eye as black splotches. When placed on a photographic plate and kept in darkness for a week, the radioactive crystals—uraninite—take their own picture (right). In 1896, Becquerel threw some ore into a lab drawer and accidentally discovered the mysterious radiation in just this way. (Photos: American Museum of Natural History)



erated. Basset's job was to count them.

After crushing and purifying the rock, he began testing for potassium. He burned the substance in a flame photometer, used the proper light filter, and let the elements write out their own vital statistics. (Each element burns with a different color.)

The tough part was finding the percentage of argon-40. First the rock was baked for a day to drive off any surface air. Then, under extreme vacuum (to prevent contamination), the rock was melted. The gases boiled off and, with the aid of liquid nitrogen, Basset froze out the argon.

This gas was shot through a mass spectrometer that magnetically separated the argon-40 from its argon sisters by atomic weight, and registered the amounts on a graph. A bit of math gave the age of the rock: 40½ million years, give or take 2 million. The Devil's Tower has been around since the Upper Eocene Epoch.

How old is the Earth? Other geochronologists are busy nailing down the age of the Earth itself. They've looked the whole world over for old, old rock. In Oklahoma's Wichita Mountains they found granite 500 million years old; in Manitoba, ores 2.7 billion years old; in Russia, remnants of "basement" rock that appeared to date back 3.4 billion years.

But none of these figures is old enough. All the rock samples show traces of sedimentary deposits—they were formed *after* the first oceans. Geochemists haven't been able to find any rock that could pos-

sibly be part of the earth's original crust.

Scientists turned to meteorites—generally accepted as remnants of some long-shattered planet that was formed at the same time as the Earth. Through potassium-argon and uranium-lead measurements, cross-checked by rubidium-strontium, they determined the age of meteorites and, by inference, the age of our Earth: 4½ billion years.

Counting backward is not always so staggering to the imagination, and it can even be more commercial than scientific.

Short-term figuring. Cosmic rays in the upper atmosphere produce tritium—one of the two isotopes of hydrogen—in tiny amounts, but highly significant to scientists. As soon as it forms, decomposition starts.

Like hydrogen, tritium combines with oxygen to form water. Rain enters our rivers and lakes, so all water—even that from your tap—is somewhat radioactive.

Tritium's half-life is 12.4 years. Thus if a sample holds only half as much tritium as fresh rain (which always has the same percentage), you know that your sample is a little more than 12 years old.

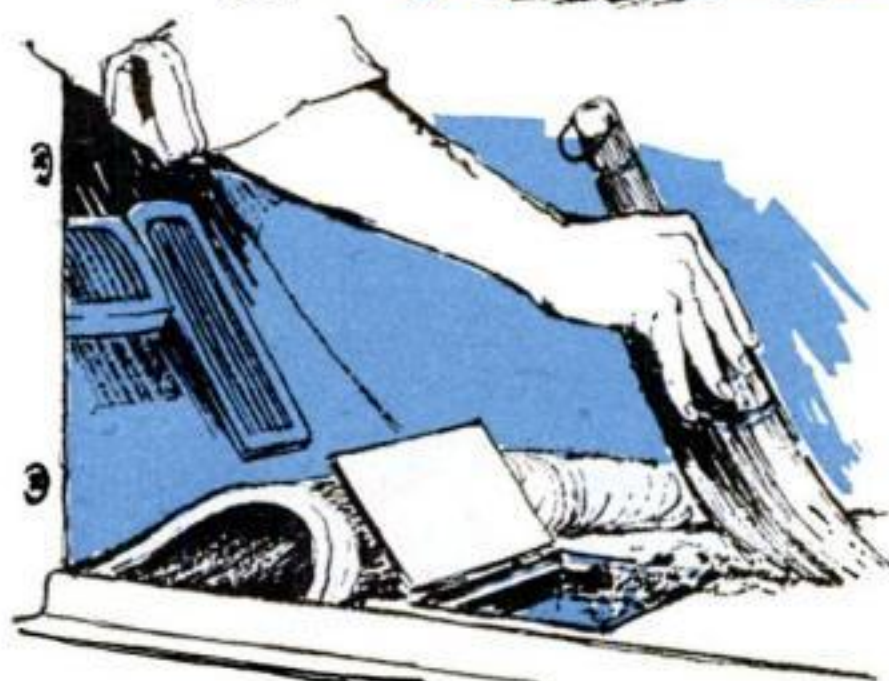
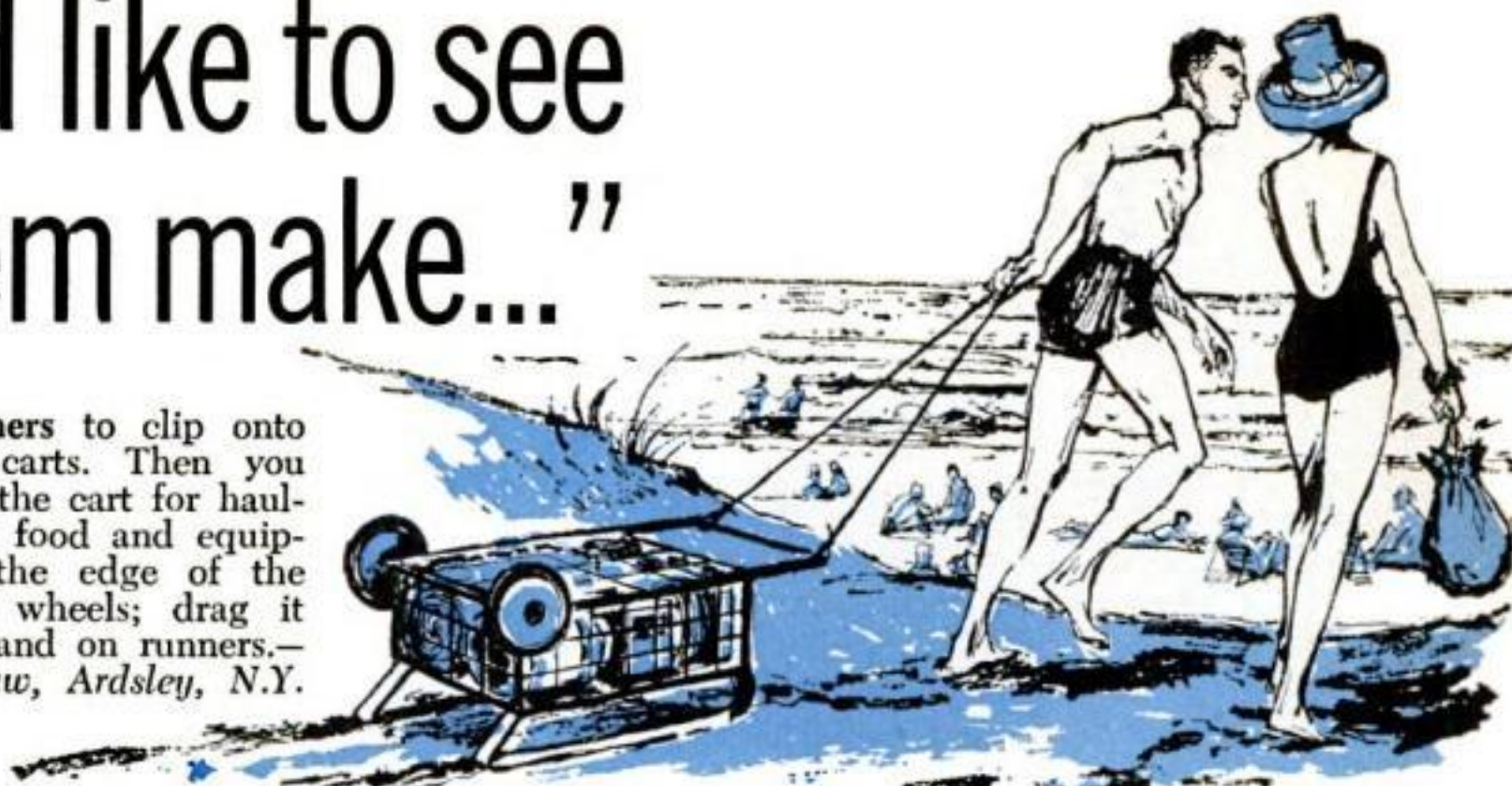
You can date liquor this way. If the label on a bottle of Old Methuselah says 15 years and investigators find a tritium content proving that the grain or grapes were harvested only 10 years ago, someone's in trouble.

Irving Friedman of the U.S. Geological Survey and Donovan L. Clark of the Smithsonian Institution worked out an-

[Continued on page 190]

"I'd like to see them make..."

Sand runners to clip onto shopping carts. Then you could use the cart for hauling picnic food and equipment to the edge of the beach on wheels; drag it over the sand on runners.—*R. A. Shaw, Ardsley, N.Y.*



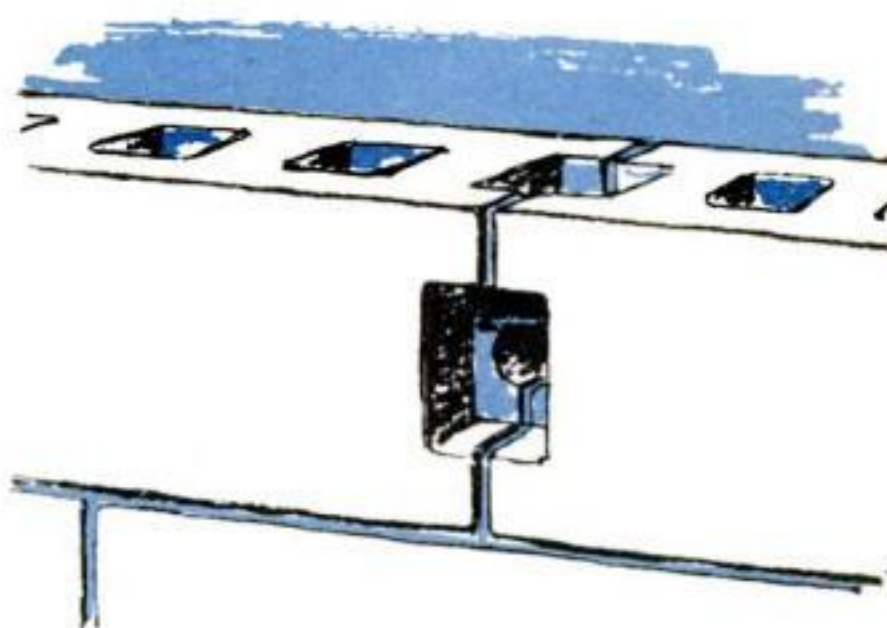
Trap doors in the floors of cars so you could whisk out sand and dirt that can't be swept out over the rise at the door sills.—*Mrs. W. S. Wilbur, Miami Springs, Fla.*



Safer power mowers with a deadman's switch in the handle. Releasing the pressure of your hand, as in a fall, would cut off current from the magneto.—*Jim Sutro, Los Angeles.*



Self-sealing pockets on swimsuits. A waterproof flapless pocket of heavy polyplastic, grooved at top so sides stick together (like Zip-Lip bags), would do it.—*R. J. West, Chicago.*



Precast building block with molded-in recesses to take electric outlet boxes. They'd save a lot of hammering and chipping out of concrete.—*H. P. Fischer, Rochester, Pa.*

Everyone has his own pet idea of a gadget that he would like to see in general use. What's yours? We will pay \$5 for each one published. Please use Government postcards

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The Other Fellow's Job:

Cake-and-steak man

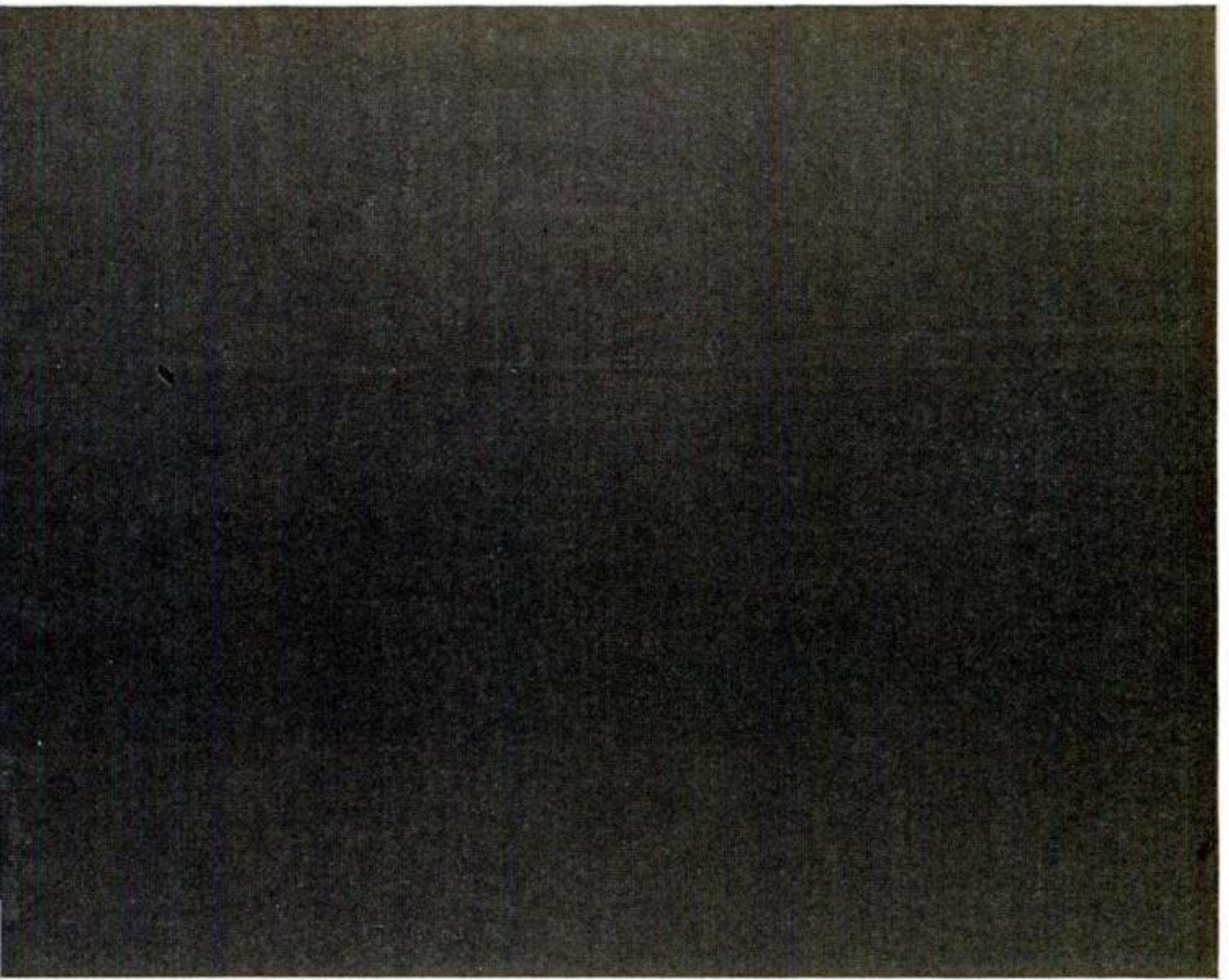
Ed (Pappy) Rhoton is one of the most popular men in the Frigidaire plant in Dayton, Ohio. He tests ovens and broilers in new electric ranges. And the way he tests them is by baking cakes and cooking steaks. Anybody who just happens to stop by when a test is being run ends up with a helping. He has no trouble enlisting volunteer tasters.

"Some of the boys in this building have a sixth sense," Rhoton says. "They seem to know exactly when the chow is ready."

Rhoton has been the cake-and-steak expert for 20 years (in the 1950s he switched briefly to test-driving cars fitted with newly developed air conditioners). He is no artistic chef, cooking by feel. Ingredients are precisely measured—each of his baking pans contains equal portions of batter weighed to 1/6 ounce. Cooking time is just as carefully controlled. If the cakes don't come out right, something's wrong with the stove.

On-the-job cookery is enough for Rhoton. "When I go home," he says, "my wife's in charge of the kitchen. And I taste."



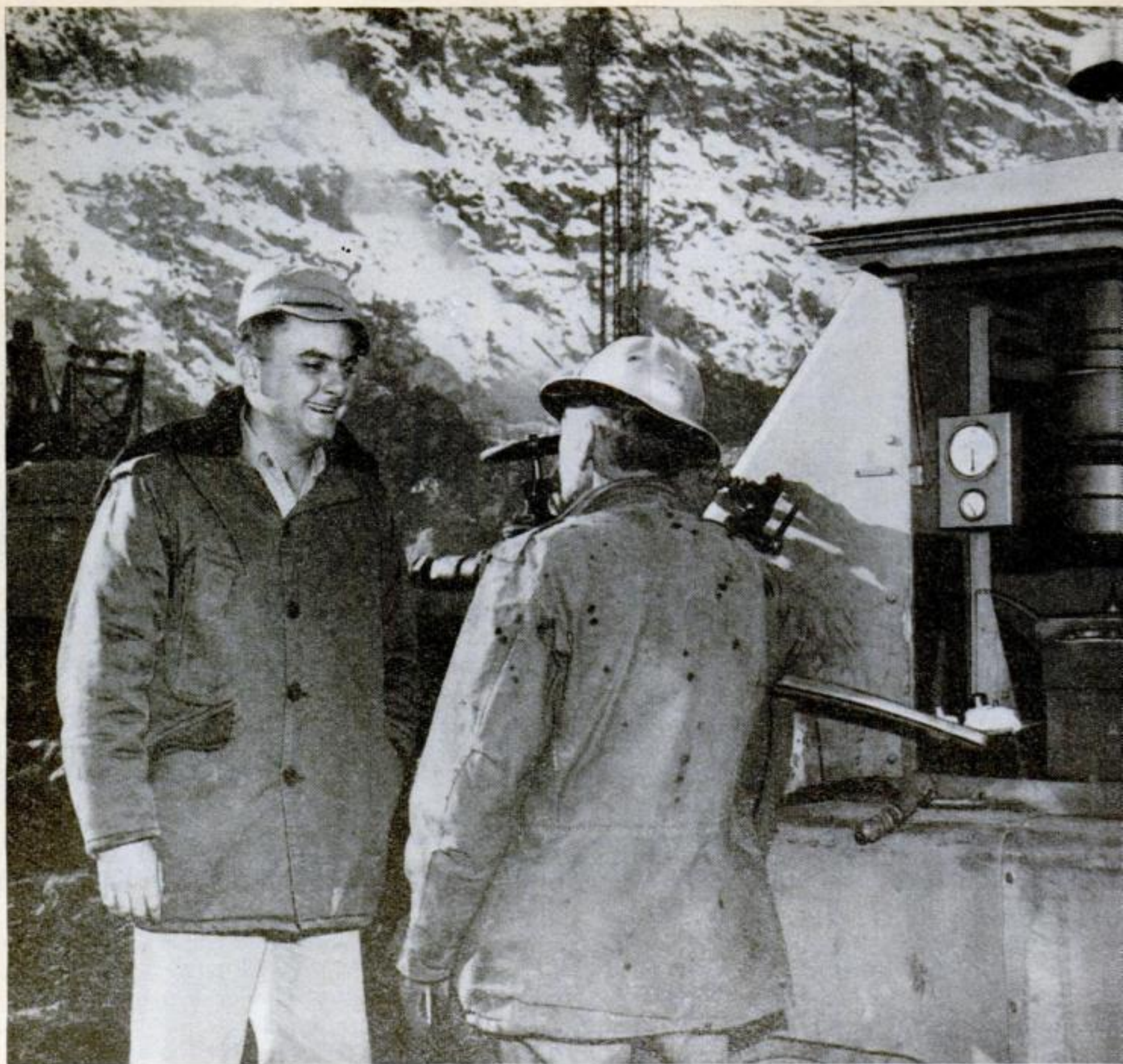


Electrician in the dark There's a man at work in that blackness: Roy A. Nitschke, electrical lead man. His job is always dark. (The lower photo was made with an infrared flash bulb and infrared film.)



Nitschke takes care of the specially built machines that slit, spool, and package camera film—what looks like white ribbon at left in the photo is freshly made film. He has a hooded, dim green flashlight so that he can see what he is doing. If major repairs are necessary, he draws a light-tight curtain around the machine. Otherwise the only illumination is the faint glow of safe-lights that keep workers from bumping into things.

Nitschke's job is critical—the machines produce so fast that any time lost in breakdowns cuts heavily into plant output. His training is impressive. After high school (Rochester, N.Y.), he enrolled in Eastman Kodak's apprentice program: four hours in class and 36 hours of on-the-job instruction every week for four years. He then studied nights at Rochester Institute of Technology. An electrical technician with his experience makes \$6,000 to \$7,000 a year.



Connoisseur of ores Big and hearty John Robertson Jr. was born to mining. His grandfather, father, and uncle all knew the industry firsthand. It's not strange that he headed from Centennial High School in Pueblo to the Colorado School of Mines to Colorado Fuel and Iron Corp.

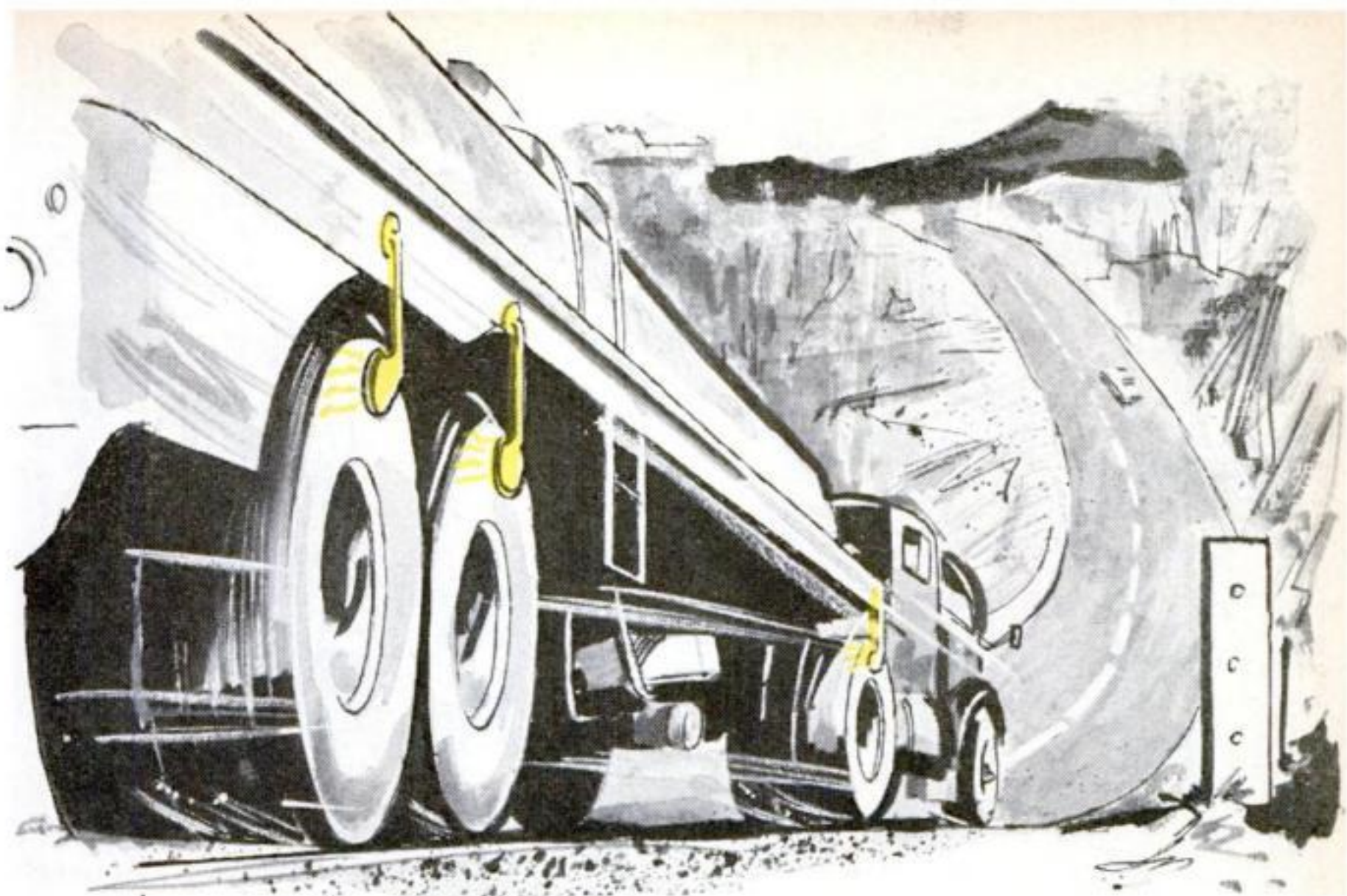
John Robertson is CF&I around the Iron Mountain pits in southwestern Utah. The mines have been thoroughly explored by now, and outside contractors perform the actual digging. It is Robertson's responsibility to fill orders from the mills.

He samples the rock that the big drag-lines scoop out of the mountain and grades it in the small lab at his office in Cedar

City. He must decide which ore from which mine—shipped by which route—will most economically meet the mills' specifications. His judgment influences company profits, which often depend on small differences in these basic costs.

Besides directing operations at three active mines, Robertson also checks once or twice a week on other claims that are still unworked. He rides the range in his car, logging 2,000 miles a month.

With mines automating, and mills growing more finicky about ores, this job requires stiff college training. And the pay corresponds: A junior engineer can expect \$550 a month, with the prospect of considerably more when he advances.



Heat detector “watches” tires. Infrared sensors, according to this recent patent, might prevent costly truck-tire damage by giving early warning when tires need air. Low

pressure causes tires to heat up fast, so these detectors would monitor temperature. When a tire got too hot, gauges in the cab would alert the driver.

New ideas from the inventors

Bulb lights watch dial. You could see the time in any light if you replaced a conventional watch crystal with a glass like this. A tiny bulb filament set into a vacuum-sealed cavity near the edge would be connected to a battery. The switch would be set in the wristband of the watch.



Rain hat carries coat. The pouch that holds a plastic, carry-about raincoat would do double duty if it zippered open into a waterproof hat cover like this (or, for women, into a hat). It would also solve the problem of what to do with the pouch when you unfolded the coat to wear it.



More inventors' ideas



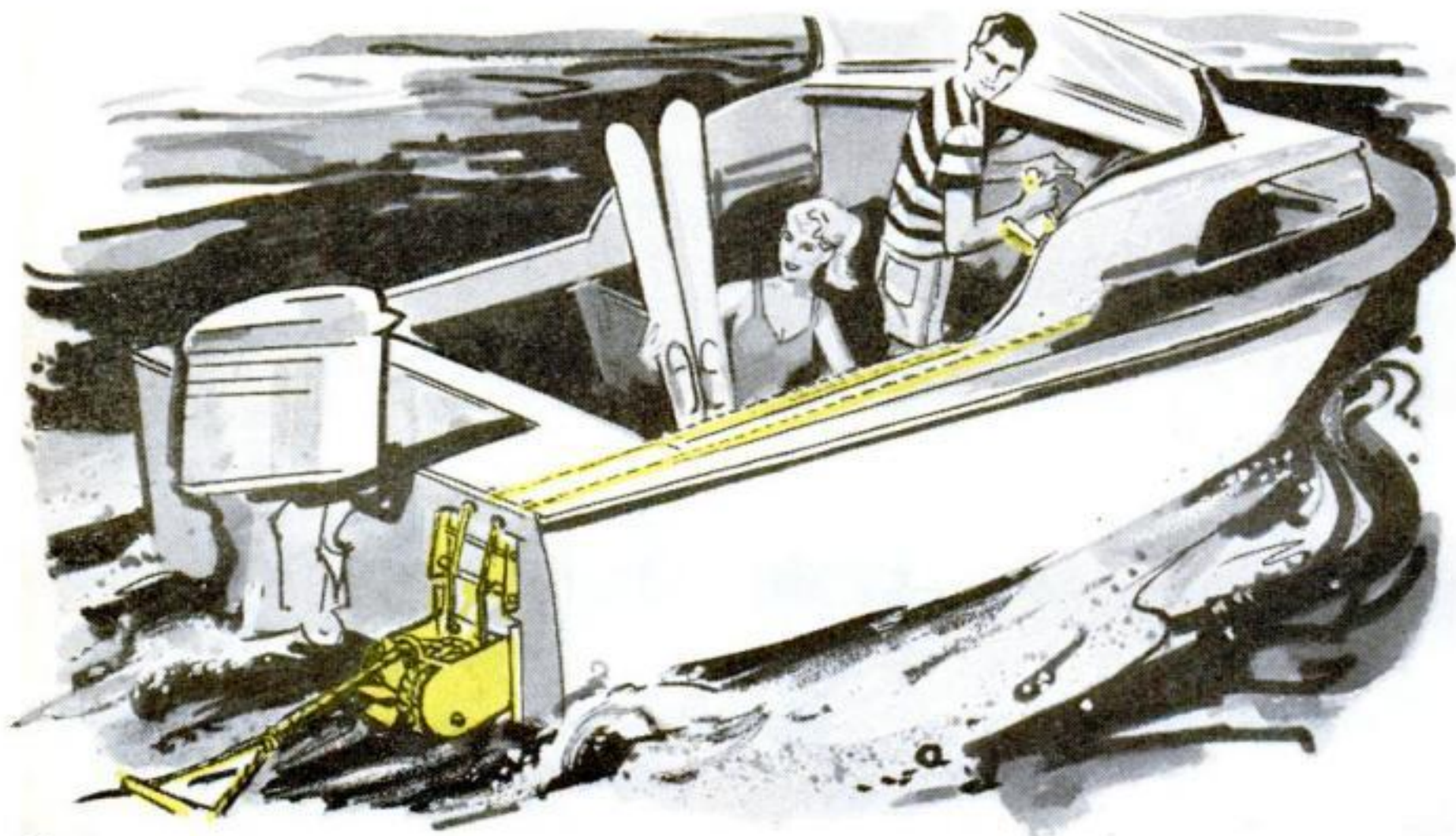
Folding sawhorse totes tools. Hinged to fold into a compact package, this sawhorse would store readily in the corner of a shop or garage but could be carried easily to any job. In use, its legs would be locked securely by a trough-shaped slip-in tray that would double as a carrier for most of the hand tools you need.



Pedal slide locks bike. You wouldn't have to carry a chain and padlock to protect a bicycle against theft if one of its pedals had this projecting bolt. Released by a key, the bolt could be moved out between the rear-wheel spokes to keep the wheels from turning. With the bolt pushed back, the bike would roll normally.

Water wheel reels ski rope. A boat operator could haul in a water skier quickly in an emergency—and effortlessly at any time—if the ski line was attached to a

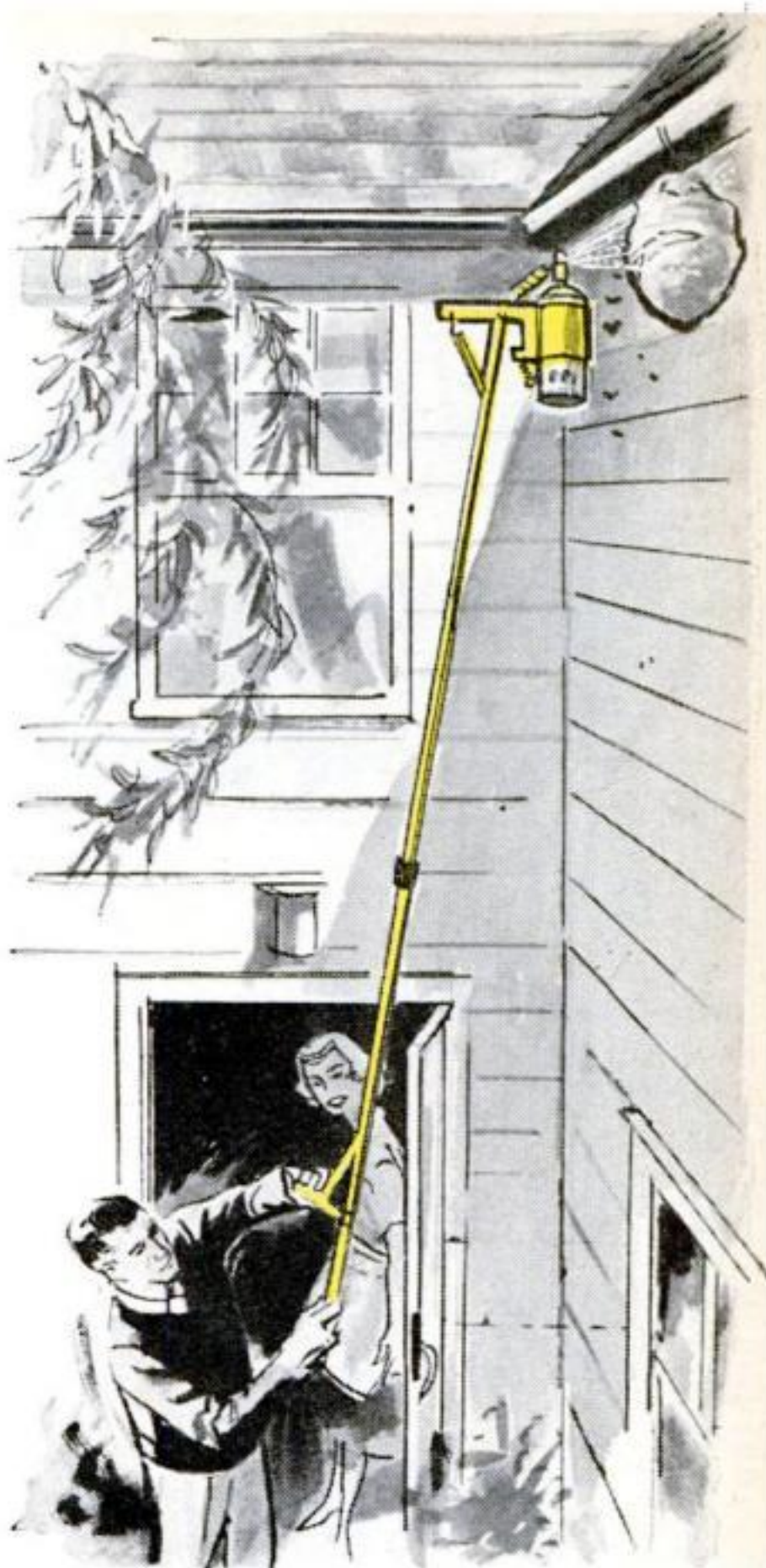
paddle wheel. One control cord would raise or lower the wheel in transom-mounted guides; a second cord would apply a brake to slow or stop the water-driven reel.





Jig bends plastic tile. Using this tool, you wouldn't need separate molding strips to finish a plastic-tile floor. Instead, you'd bend up the end courses to fit the walls. You'd soften a tile in hot water, clamp it in the tool, and roll a smooth curve. A knob would move a stop to set the bend position and keep all bends uniform.

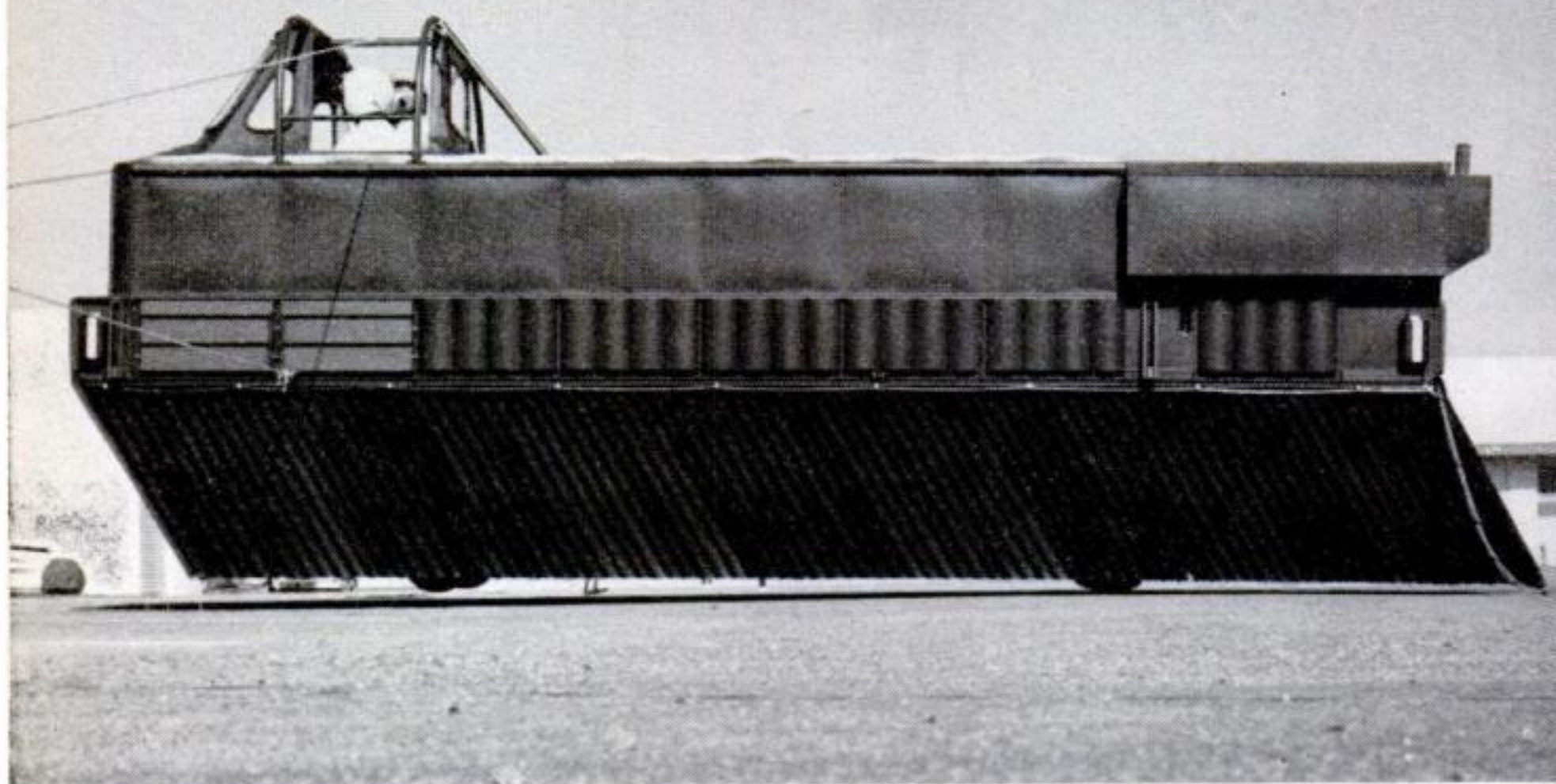
Pan stirs its contents. Socketed on a motor-driven spindle, a revolving blade in this pot would stir food steadily as it cooked. The spindle and motor would be set below the heating element of an electric stove. The blade would engage a tall, leakproof shaft in the center of the pan, and would be removable for cleaning.



Pole extends spray can's reach. You could root out wasps' nests from a safe distance or aim paint or plant sprays at hard-to-reach spots with this extension pole. You'd slip a pressure can into the end clamp and fit a spring cap over the nozzle. A lever would let you control the spray.

The following patents have been issued on these inventions: Tire guards—No. 3,015,803 to W. Neu, Alpine, Tex.; Watch light—No. 3,018,614 to A. Brien, Montreal; Pouch hat—No. 3,011,173 to C. Goetz, Lisbon, Portugal; Sawhorse—No. 3,016,104 to D. Johnson, Albuquerque, N.M.; Pedal lock—No. 3,009,348 to L. Colbert, Washington, D.C., and W. Colbert, NYC; Paddle wheel—No. 3,011,469 to D. Falkner, Columbiana, Ala.; Tile bender—No. 3,020,590 to W. Siegert, Widewater, Alberta, Can.; Stirrer—No. 3,005,399 to M. Libson, New Haven, Conn.; Spray pole—No. 3,017,056 to C. Bishop, Framingham Center, Mass.

Copies of patents may be ordered, by number, from the Commissioner of Patents, Washington 25, D.C., at 25 cents each. To write to an inventor, if the address given above is insufficient, address him (by name and patent number) in care of the Commissioner of Patents.



First lift-off: In tethered test, 21-foot-long experimental vehicle rises on a cushion of air

vented through 14 ducts, 7 on each side. In operation, the wheels will be retracted.

No-Wheels Truck to Go Anywhere at 40 m.p.h.



Riding on a cushion of air compressed under a kind of hula skirt, an experimental ground-effect machine will soon be given its first off-the-road tests.

Due to be ready any day now to whisk over field or flood at 40 m.p.h., the ingeniously designed 3½-ton GEM is taking shape at Ford's Aeronutronic Division, in Newport Beach, Calif. It is expected to be able to range 100 miles at top speed, and climb 20-percent grades.

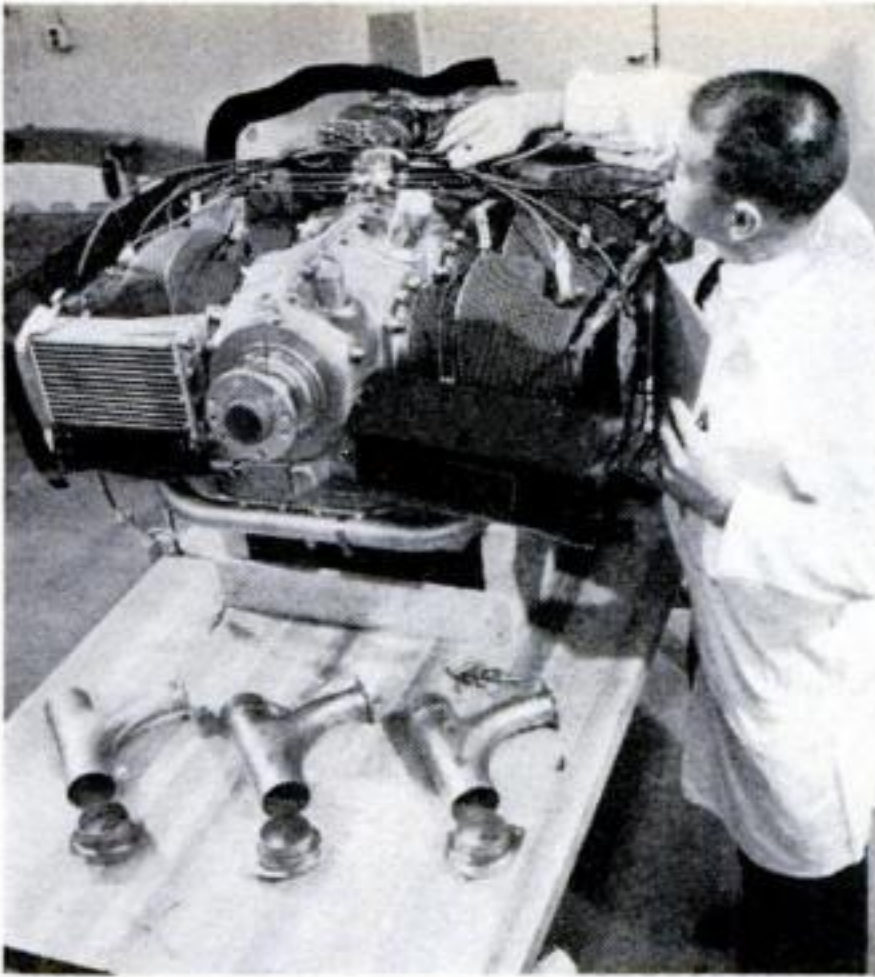
The wheel-less olive-drab vehicle is 21 feet long and 8 feet wide, with a 4-by-13-foot cargo space. When under way with

a one-ton payload, it will clear ground, water, or ice by two to three feet. It can land on a river or lake and take off from there, too. Movable louvers along the sides and across the front and rear of the chassis vent the air trapped underneath to propel, steer, or brake the machine.

Seven fans, facing straight up under a metal grille, suck in enough air at full throttle to build up 50 pounds of pressure per square foot beneath the truck body. The vehicle's stiff plastic skirt keeps the air from escaping aimlessly.

For controls, the driver has a steering wheel, two hand throttles, and two pedals. The steering wheel is cable-linked to yaw-control louvers in the four corners of the machine. One pedal opens rear louvers and angles side louvers to provide forward thrust. The other pedal is the brake. It closes rear louvers and opens front ones, at the same time angling the side louvers to provide reverse thrust.

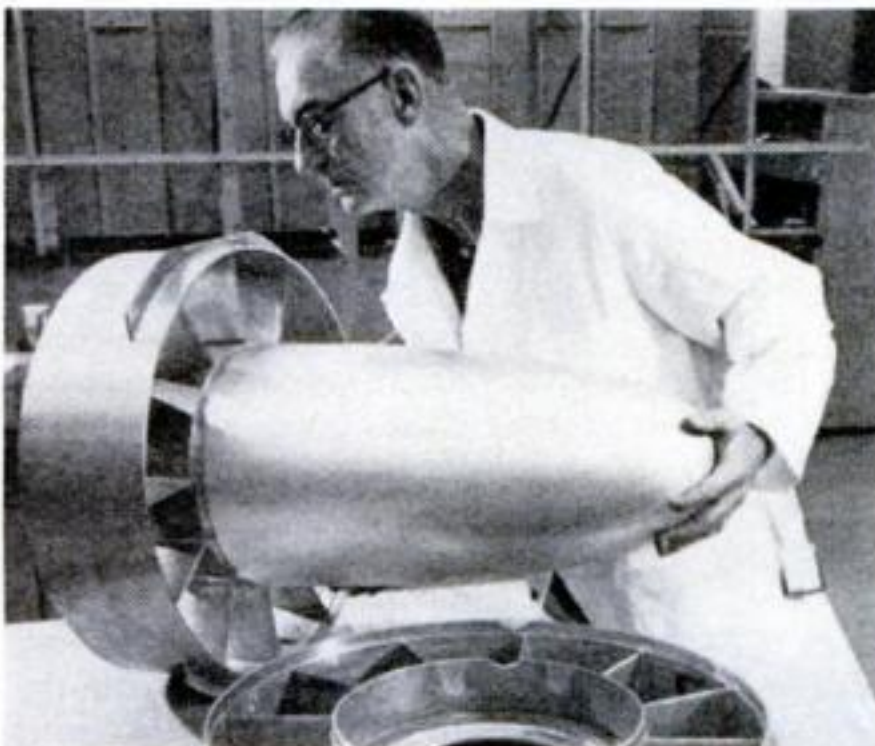
When the driver spins his wheel to the right, he automatically opens left-front and right-rear yaw louvers. These force the vehicle's nose to the right and its rear end to the left. It then rounds the turn in an airy skid. The no-wheels vehicle is intended primarily for military use—for the present at least.



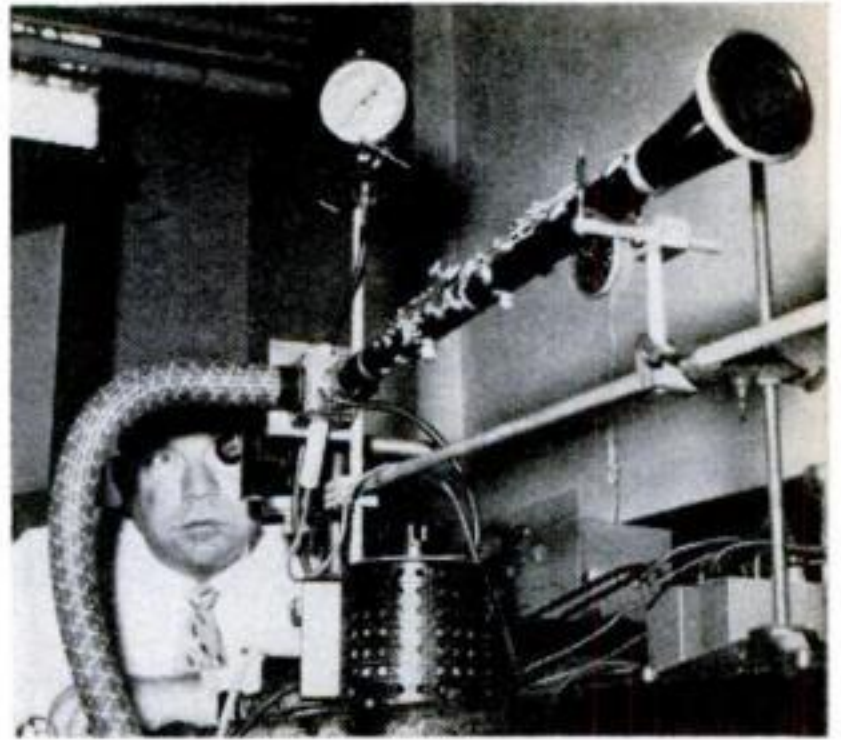
Six-cylinder aircraft engine is one of two Continentals used to power experimental GEM. Special Ford engine will run production vehicle.



Experimental chassis takes shape at Ford's Aeronutronic Division. Rollout of actual ground-effect machine is scheduled for midsummer.

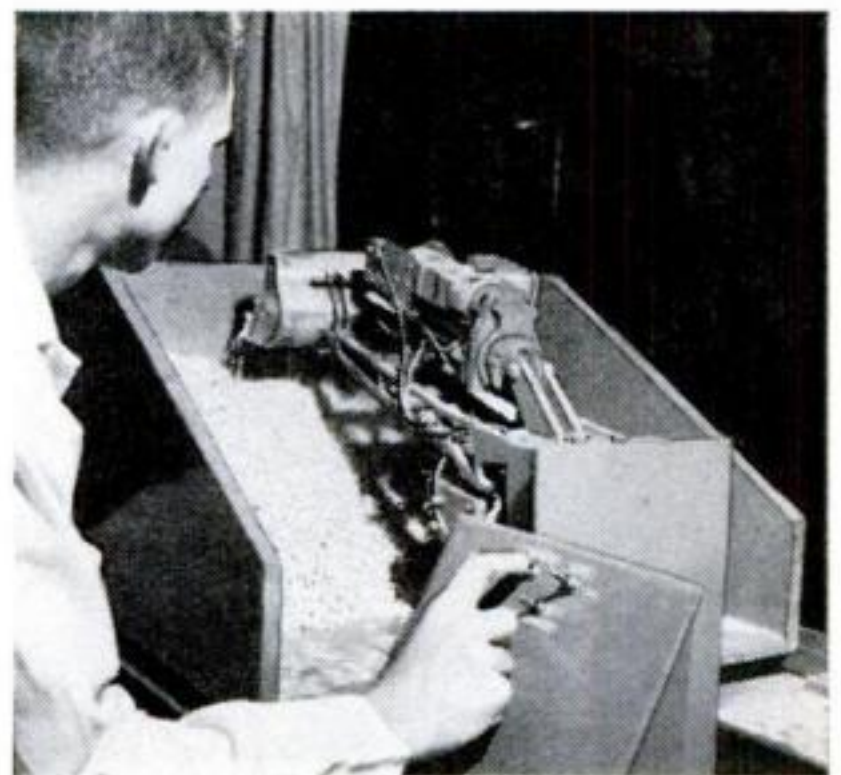


Seven fans like this—each 21 inches in diameter—will be mounted on each side of cargo space. Cone helps direct flow of air sucked in by fans.



Music from a vacuum cleaner

The exhaust from a vacuum cleaner blown through a clarinet makes music for Dr. John Backus at the University of Southern California. Dr. Backus rigged the machine to the clarinet to provide "lung" power for playing hours at a time. He is studying the acoustics of musical instruments under a grant from the National Science Foundation and hopes his research may lead to simpler, more reliable instruments. Oh, yes, he still has to depress the clarinet keys himself in order to vary the notes.



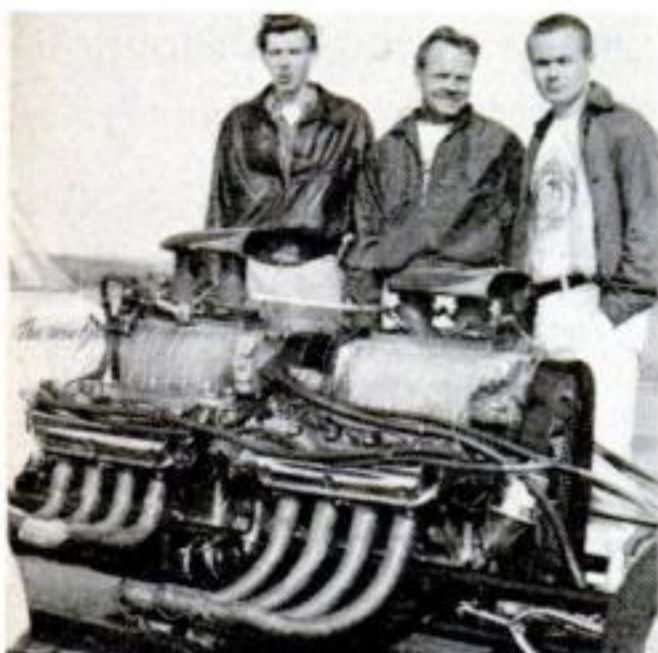
Miniature earth mover

Scale models of loading buckets, bulldozer blades, and scrapers give Caterpillar Tractor performance data on new configurations before they are put on earth-moving equipment.

In the photo above, a newly designed bucket for a front-end loader is shown scooping up pelletized limestone in a test trough.

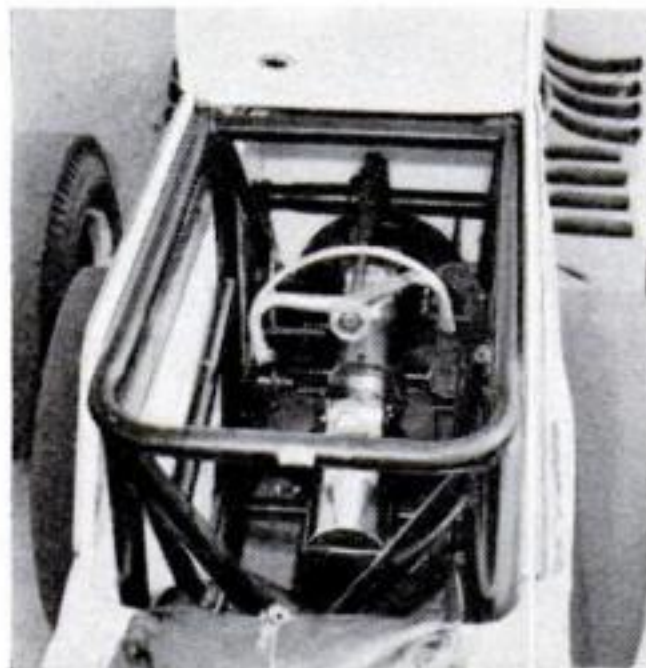


Double tubular frame supports heavy engines. Parachute at rear helps stop car at end of run.



Roller chains from the crank shafts drive the GMC blowers. Looking on proudly are owners (left to right) Neil Leffler, Bill Coburn, and son Glenn—all from Hawthorne, Calif.

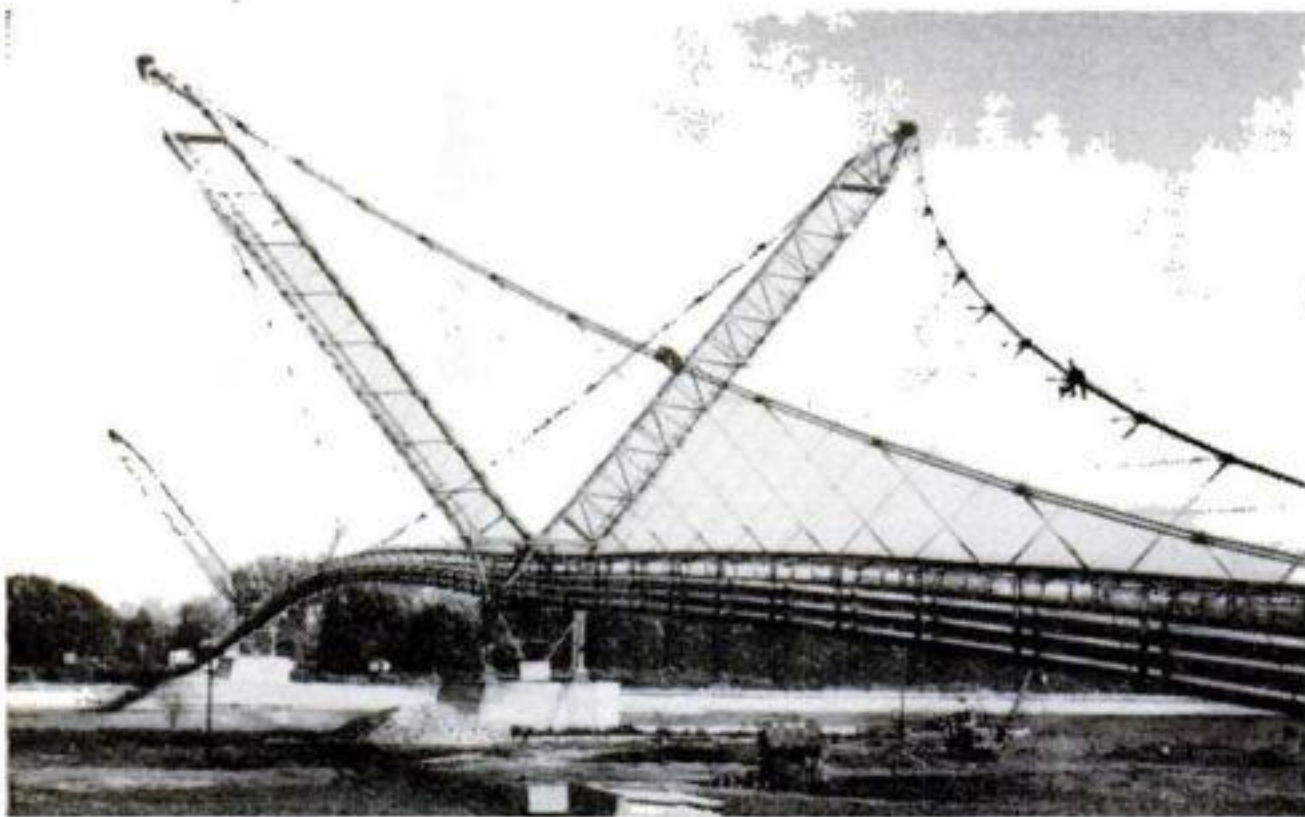
None of the comforts of home: Driver sits with legs sprawled, straddling rear end. There's no transmission—just high gear. Sturdy, well-braced frame provides good rollover protection.



Two-engined dragster races on six wheels

Two engines are better than one, say the three men who built this dragster. The car, classified as a modified coupe because of a handmade cabin at the rear, is one of the heaviest to invade a drag strip. It boasts tandem Chrysler V-8s connected to a single drive shaft that turns four driving wheels.

These mount slicks (treadless tires) for better traction. The car, built in nine weeks, cost \$7,500. It's already turned 179 m.p.h. in 9.2 seconds, in a standing-start quarter mile on a shakedown run. The owners are aiming for the still-unattained mark of 200 m.p.h.



Oil-bearing bridge crosses Danube

"Winged" pylons carry 13 pipelines over the Danube near Schwechat, Austria. A 28-foot height at center lets ships pass under.

Three pipes convey gasoline, three crude oil, three gas, two heating oil, one petroleum, and one is kept as a reserve. At each end of the bridge, the pipes go underground.



Last chance to save the Bald Eagle



Belied by slanderous myths, America's symbol of power and freedom is now dangerously close to extinction—doomed by kill-happy bird hunters

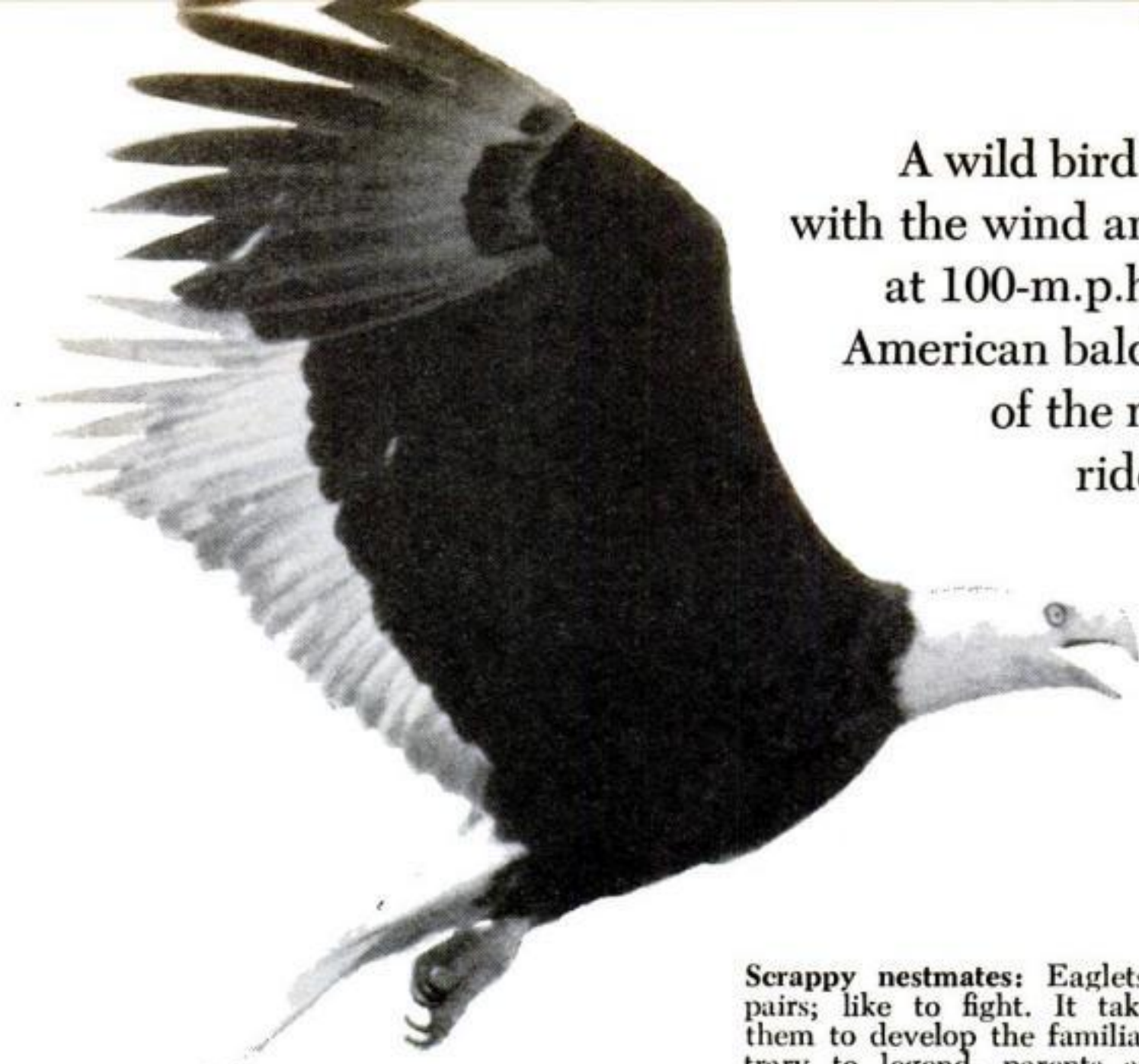
By Richard Petrow

IN A Midwestern state last month a motorized potshooter—one of those so-called “sportsmen” (fortunately rare) who cruise the highways killing anything and everything in sight—spotted a giant American bald eagle circling high above the trees. Without a moment's hesitation he eased his car to a stop, zeroed in on the majestic bird, and brought him down with one shot. Then he drove off. He had made his kill . . .

In Florida, two teen-age boys exploring a coastal marsh located an eagle's nest high in a lonely pine. They climbed up to see if there were any eggs in it. There

Eagle eyries are built high in the treetops. Nests can weigh two tons; last the birds a lifetime.

CONTINUED



A wild bird that can soar
with the wind and crash-dive
at 100-m.p.h. speeds, the
American bald eagle is one
of the most majestic
riders of the sky

Scrappy nestmates: Eaglets usually hatch in pairs; like to fight. It takes three years for them to develop the familiar white head. Contrary to legend, parents are good providers. ►

were two. Both splattered as they hit the ground . . .

In upper Wisconsin, a farmer muttering something about "damn chicken killers" brought down a young eagle that had just migrated into his locale. The farmer knew about the \$500 fine for killing bald eagles, but he also knew that if the game warden came around he could say he thought it was a hawk . . .

Just three incidents: two birds dead; two more that would never fly.

Incidents such as these, repeated over the decades, have brought the bald eagle to the brink of extinction in all states except Alaska. In fact, the big birds that are the symbol of American power and freedom are so rare that ornithologists now keep tabs on them individually.

The last count of the eagle population put the number of birds at only 3,642. And that's declining steadily.

In 1958, the Fish and Wildlife Service warned that the bald eagle (*haliaeetus leucocephalus*, to be exact) was in serious danger of extinction. That was when the National Audubon Society entered

the picture, launching a five-year Continental Bald Eagle Research and Conservation Program to save Old Baldy.

Folklore and fallacy. More nonsense has been written about the bald eagle than about almost any other wild creature. He's usually characterized in one of two ways:

- He is a fierce marauder in the sky, who swoops down to carry off and kill household pets, poultry, young lambs, and even children.

- He's a clumsy, cowardly, carrion eater who lives by stealing and is too timid to defend his own young.

Both views are wrong.

When you're dealing with the bald eagle, you have to take him as he is.

To start with, he's a predatory bird—like the owl or the hawk—and he lives by eating creatures weaker or slower than he is.

The diet of the bald eagle varies, naturally, with his locale. A Florida naturalist once examined some eagle nests when the birds were away. In one nest there was the skeleton of a mullet that



had weighed two pounds, in another the remains of a full-size black duck. He also found evidence that the birds had dined on rabbits, turtles, coots, pied-billed grebes, little blue herons, snowy egrets, terns, killdeers, catfish (a favorite), black bass, and pompano.

Despite persistent rumors to the contrary, the bald eagle does *not* eat cocker spaniels; and he doesn't attack children. Though he is one of the largest birds aloft, with a wing span that can reach seven feet, the eagle weighs a maximum of 10 pounds.

Like most birds of prey, the bald eagle isn't fussy about his food or about who does his hunting for him. A screaming dive by the eagle, and an osprey is only too glad to drop his meal and flee.

The detractors. These traits have long given the bald eagle a bad name. Complained Benjamin Franklin: "For my part I wish the bald eagle had not been chosen as the representative of the country; he is a bird of bad moral character; he does not get his living honestly; he is generally poor and often very lousy. Be-

sides, he is well known as a rank coward."

What bird did Franklin want as our national symbol? The turkey gobbler. "A much more respectable bird," Franklin remarked.

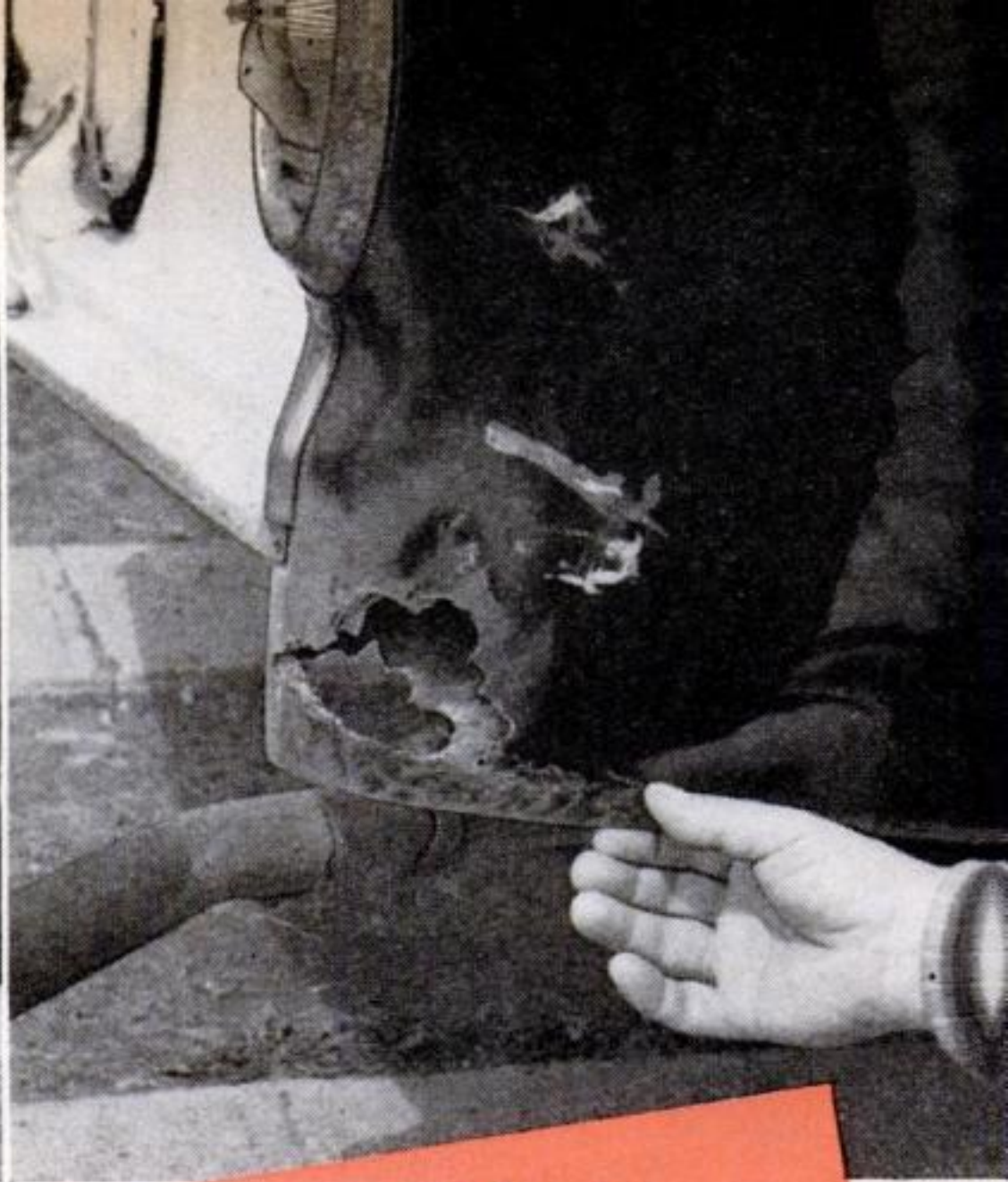
Respectable or not, the bald eagle became our national symbol in 1782.

But attacks on his character have con-

[\[Continued on page 192\]](#)

Spotting a fish from as far as three miles away, the eagle zooms to the spot, drops like a dead weight, then levels and brakes like a jet on a short runway. Talons carry the loot home.





**Save \$81 ⁰⁰ on
Rocker Panels**

SHOP CHARGE: \$90.00
DO IT YOURSELF: \$9.00

**Save \$57 ⁵⁰ on
Rusted Fender**

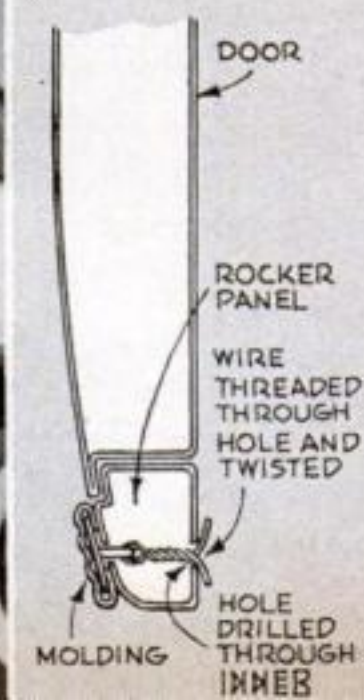
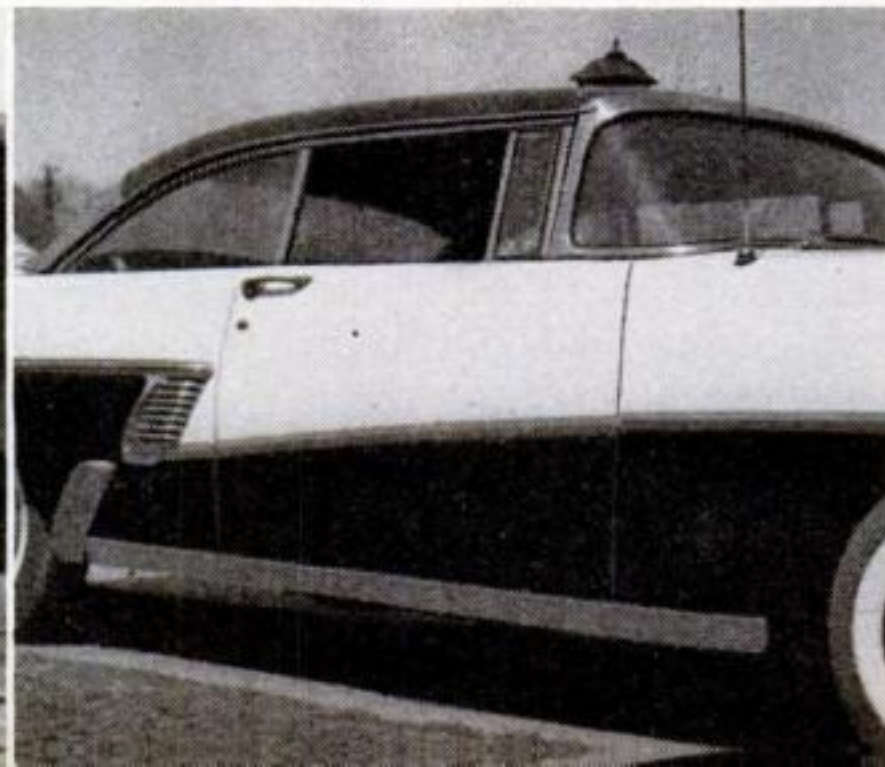
SHOP CHARGE: \$65.00
DO IT YOURSELF: \$7.50

A QUICK FIX



Hide rusted rocker panels behind moldings

Accessory trim strips come in 2½" and 3½" widths for wide and narrow panels. The strips telescope like curtain rods to fit any car length. Drill 5/16" holes in the panel wherever metal is sound, and then snap clips into the holes to hold the trim. Kit includes a template for properly aligning the holes. Press trim into place with the palm of your hand. If metal is so badly rusted that there's no place to drill holes, drill through the metal behind the rocker panel and fasten trim in place with copper wire. Twist the wire with a pair of pliers until it holds the trim tight.





**Save \$154 00 on
Collision Damage**
SHOP CHARGE: \$175.00
DO IT YOURSELF: \$21.00

By Herbert R. Pfister

BODY rot, "lace," or just plain rust—they all mean the same thing: ugly flaking and ragged holes in the body panels of your car.

These symptoms usually have meant high body-shop repair bills. So have those minor dents so easily acquired in today's heavy traffic. But new repair kits consisting of epoxy resin and fiber-glass now make home repairs easy. The bodies of the Chevy Corvette, Studebaker Avanti, and several foreign sports cars are built entirely of these same plastic materials—proof enough of their durability.

For \$10 or less you can do a job that would cost \$100 if you took your troubles to a body shop. In fact, many shops use the same repair kits that you can now buy at auto- and marine-supply stores.

Do-It-Yourself Body Repairs That Save You Big Money

When fixing collision damage with fiber-glass, you don't need to iron out dents to the original contour. Thick layers of the catalyst-activated materials harden as well as thin layers. Just hammer out the dents the best you can, clean the metal so that you'll get a good bond, and fill in the low spots with a puttylike filler reinforced with powdered fiber-glass. In less than an hour the repair can be filed to shape, sanded smooth, and painted. In a few hours the repair is hard as rock.

Matching paint for almost all cars can be bought in inexpensive aerosol spray cans. For painting large areas, such as hood, deck lid, or doors, it's worth renting a spray outfit.

The accompanying photos show how to repair rusted areas and dents on your car. You can use the same techniques on dozens of fix-it jobs around the house, too.

RUST HOLES

Epoxy resin and fiber-glass cloth replace metal that's eaten away



1 Depress metal around area to be patched; this saves much feathering around edges later. Sand off all rust and paint. Cut two or more pieces of fiber-glass slightly larger than hole. Cardboard behind hole backs up fiber-glass.



2 Saturate layers of fiber-glass cloth with resin to form the patch. Working on a sheet of vinyl, spread the resin liberally over each layer and cover with another fiber-glass sheet. Iron out air bubbles with your fingers or a straight stick.



3 Coat working area with resin left over after saturating the fiber-glass. This primes the metal, helping the patch to stick better. Epoxy cures faster at high temperatures; work in the shade to prevent hardening before cloth is laid on.



4 Press patch in place over damaged area, using the sheet of vinyl to keep resin from getting on your hands. Leave vinyl in place while you pat the patch firmly against the metal. After the resin hardens, the vinyl will peel off.

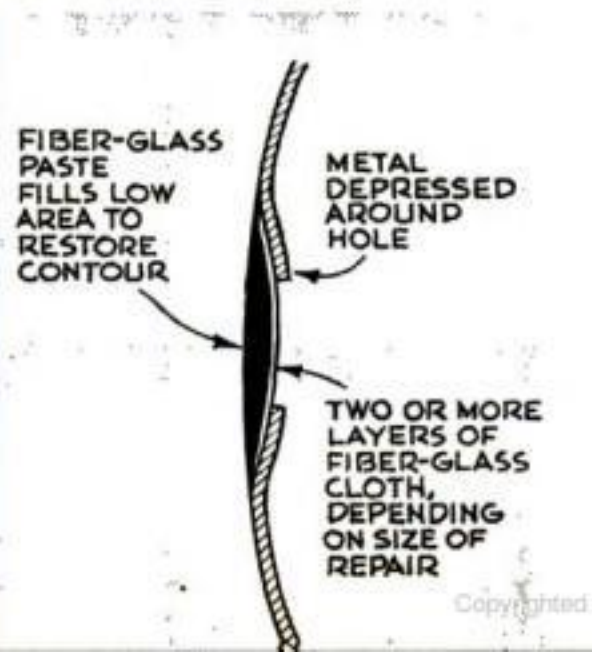


5 Paste consisting of powdered fiber-glass (supplied with many kits) mixed with resin makes a good filler for low areas after patch cures. Apply with rubber squeegee. In below-70-degree temperature, use heat lamp 18 inches from patch.

6 Sand entire working area smooth and feather all edges flush with surrounding paint. Sanding may disclose more small low spots; for a perfect job, fill them with fresh filler paste, and sand again. Finish surface with fine sandpaper.

7 Spray on a couple of coats of canned primer. When dry, apply paint to match your car finish. Start with several light mist coats, then a heavier wet coat. Polish the area with rubbing compound to blend repair with surrounding finish.

8 When metal is depressed around the hole before the fiber-glass is applied, a flush patch is assured. Also, the bond is stronger, since you now have more contact area. Low spot in center of patch is filled with paste and sanded smooth.





COLLISION DAMAGE



The easy way to
smooth out dents
and wrinkles:
plastic putty

1 How much? Body shops quoted prices of \$150-200 to straighten this rear fender and install new tail light, side trim, bumper. With fiber-glass, damage was repaired in two weekends for \$21, including parts bought at a wrecking yard.

2 Junkyard tail light (\$3) is mounted to check fender contour during hammering-out operation. Paint has already been ground off. Vise-grip pliers, scissor jack, a piece of pipe, all make fine tools where there's no room to hammer.



3 Used side-trim spear (\$1) also acts as a guide in bringing fender back to original shape. Instead of mounting the trim, hold it against the fender frequently. Finger points to $\frac{1}{2}$ "-deep depression. It can be filled in one application.

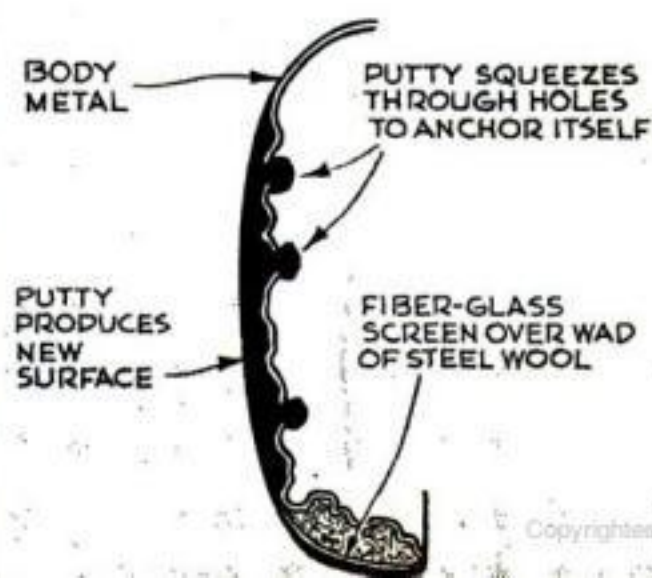
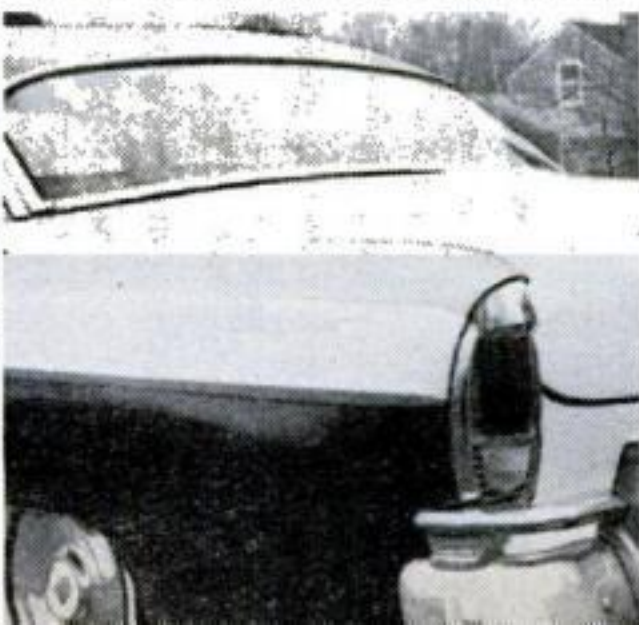
4 Resin filler cures quickly, so mix a small amount at a time. About 10 drops of catalyst (supplied in kits) is usually mixed with heaping tablespoon of putty. After stirring thoroughly, spread putty out thin on glass to retard curing.

5 After drilling several $\frac{3}{16}$ " holes in the metal to help anchor the patch, apply putty with a squeezegee. If metal is torn or punctured, reinforce it with fiber-glass screen before laying on putty. It works like reinforcing mesh in concrete.

6 Shape fiber-glassed area and fair it into the tail light and surrounding area, using a body file. Here area above side trim has been filed; area below hasn't. Finish smoothing with medium and fine sandpaper, as in rust-repair sequence.

7 Spray several coats of matching paint over the fender. Now stand back and admire the job. The old bumper could have been straightened, but a used one was about as cheap (\$8). Junk yards are dandy if you own a popular car.

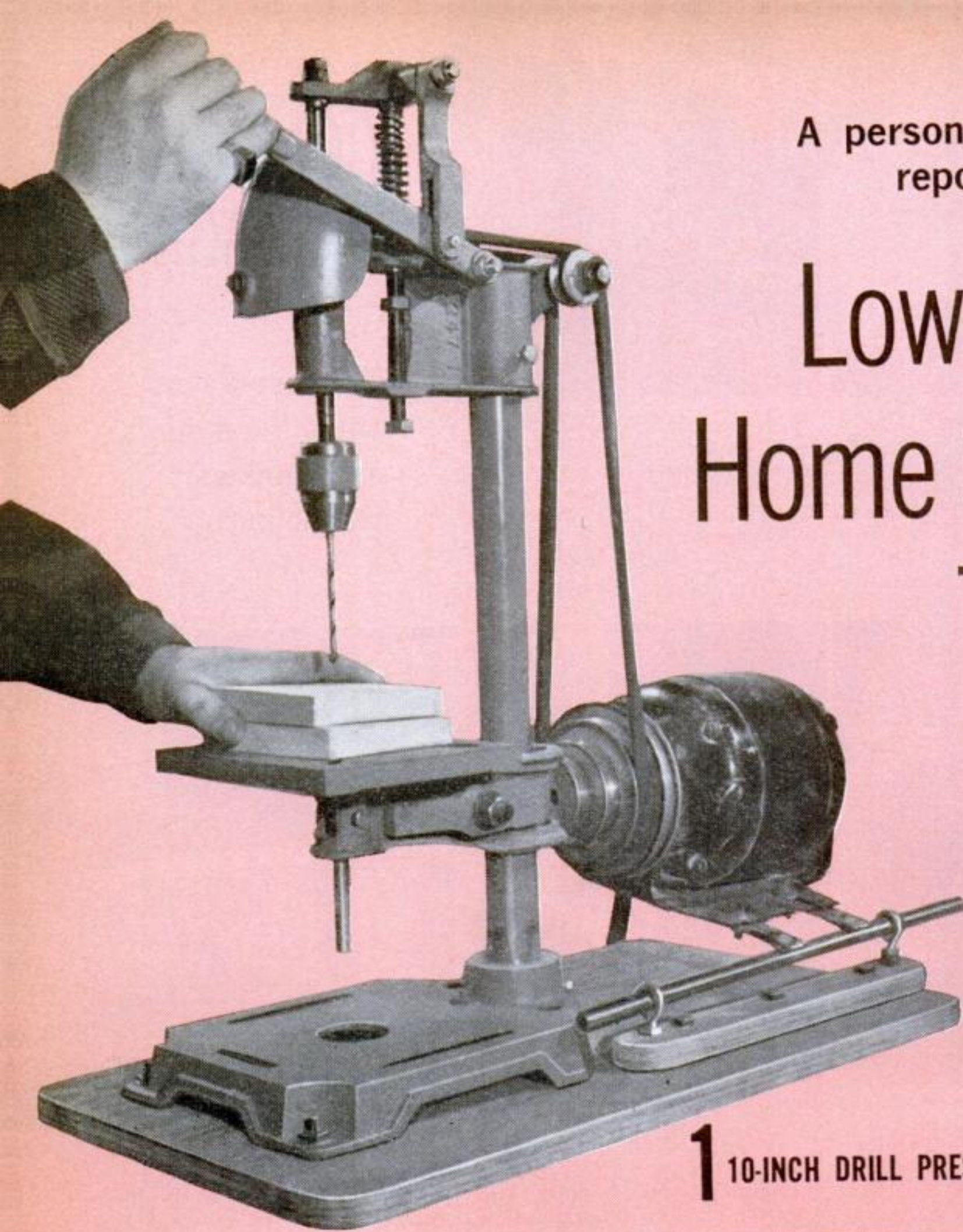
8 Cross-section diagram shows what to do when a dent is inaccessible from behind for hammering out (as in some doors and quarter-panels). Pack damaged area with steel wool; then cover with fiber-glass screen and a coat of putty.



A personal-use
report on

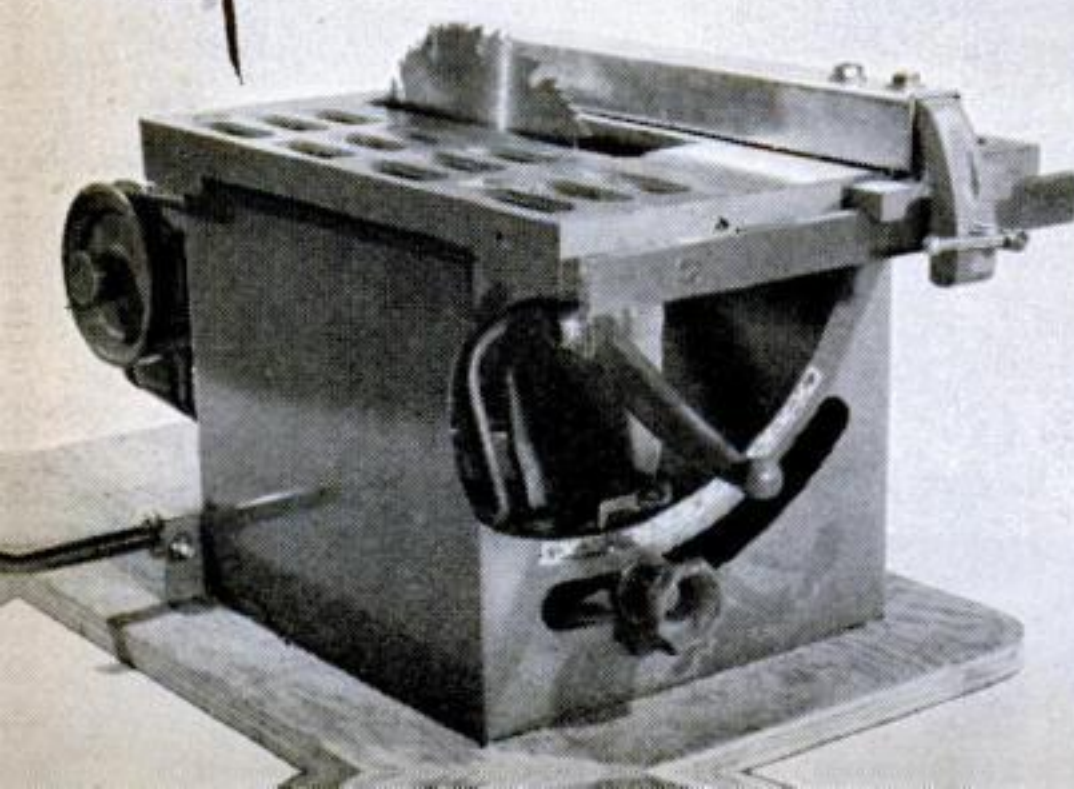
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Low-Cost Home Shop Tools

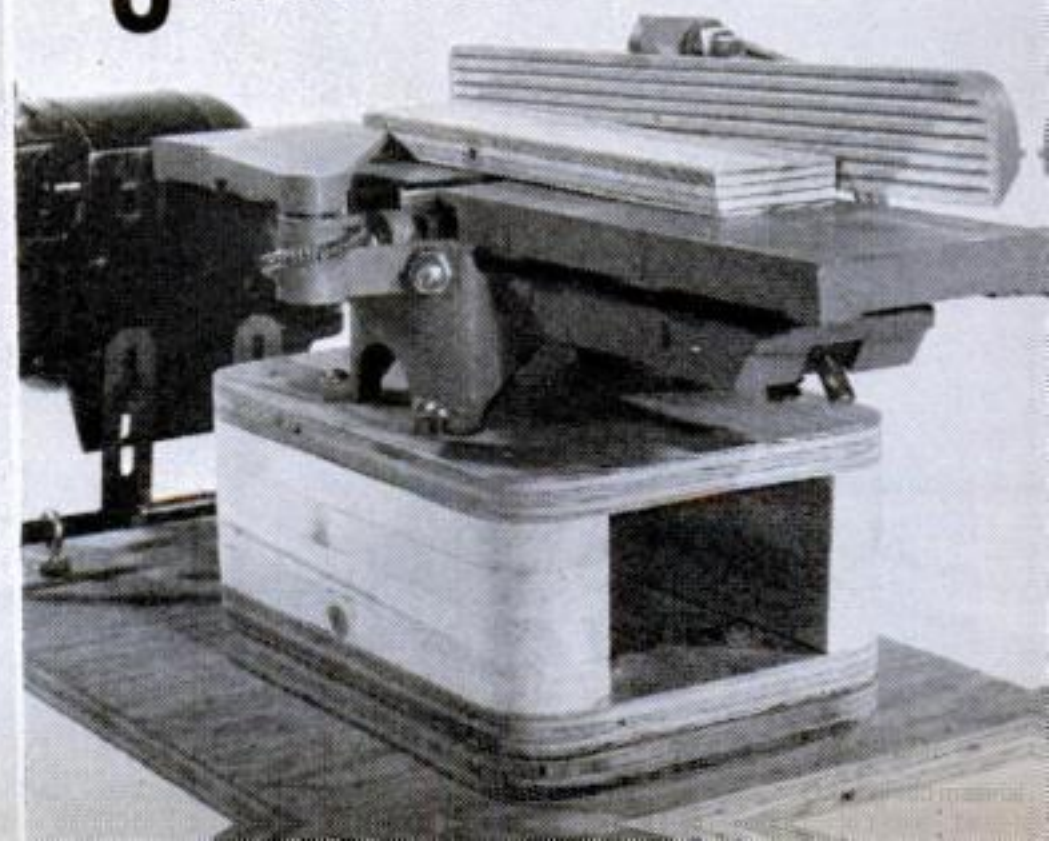


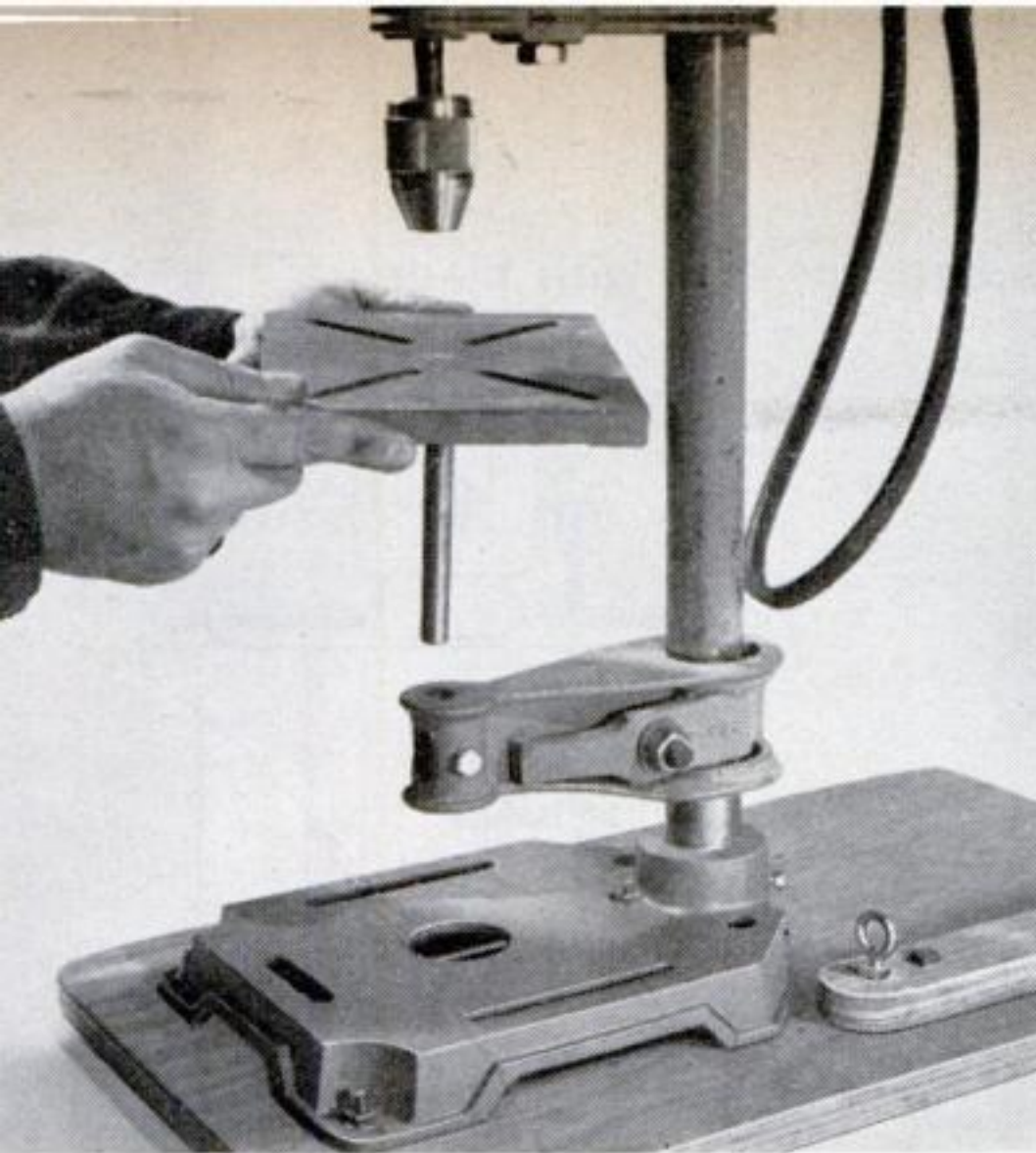
1 10-INCH DRILL PRESS

2 8-INCH TILT-ARBOR TABLE SAW

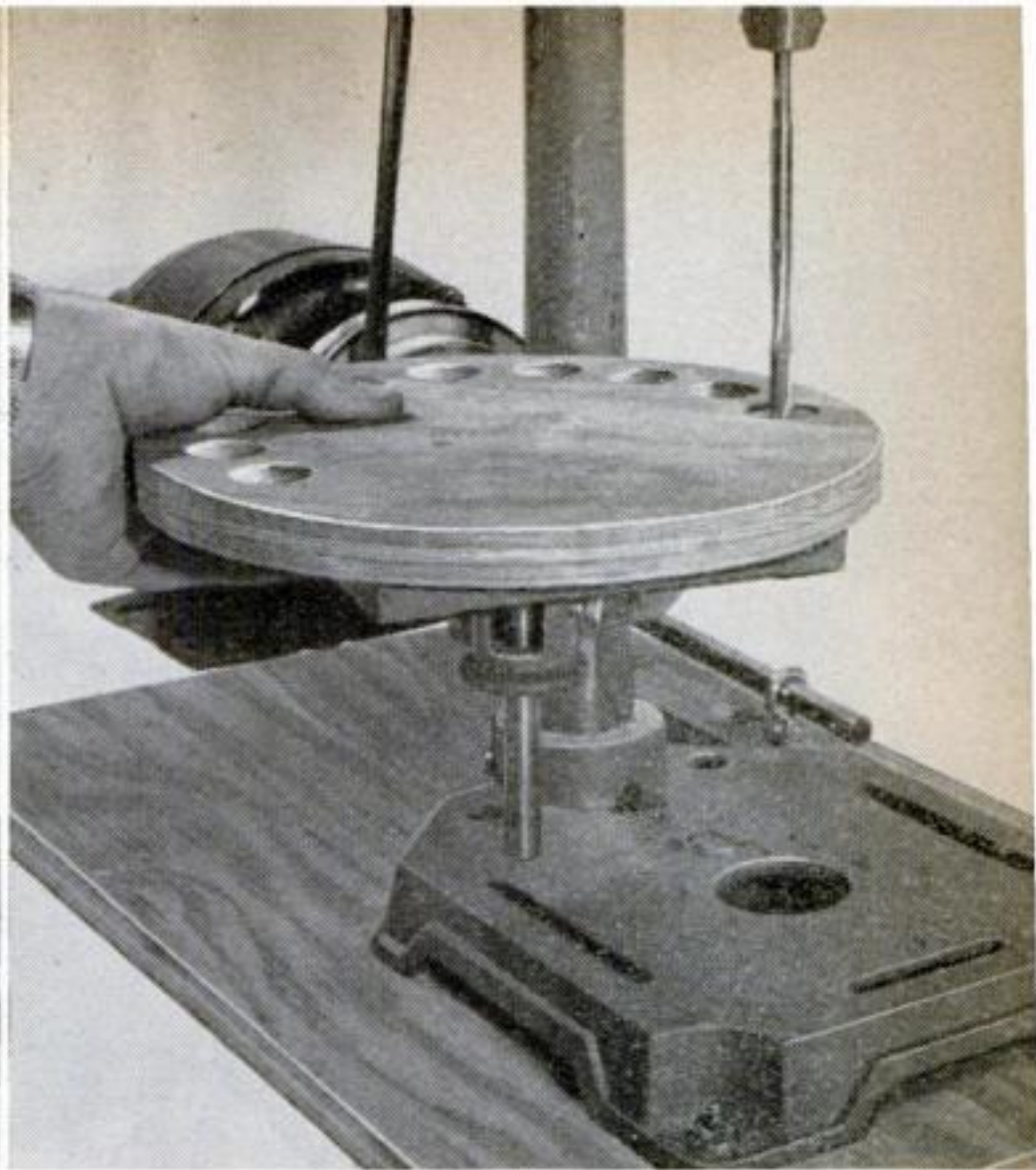


3 4 1/8-INCH JOINTER-PLANER





This rotating table is one of many pleasant surprises offered by the \$19.95 drill press. It slips into a socket in the arm, can be moved



up or down without disturbing the arm itself. Its swivel action lets you drill a series of holes in rapid succession, as above.

By Sheldon M. Gallagher

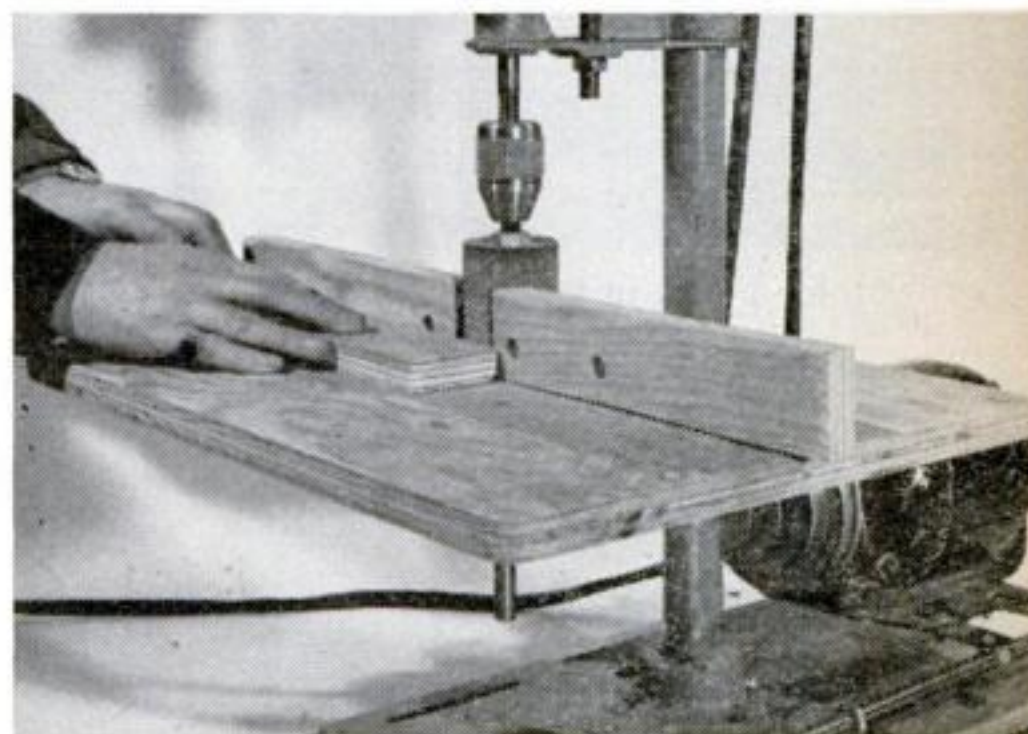
THE price tags say: Table saw—\$9.95. Drill press—\$19.95. Jointer—\$19.95. These are no woodworker's fantasy. They're for real—part of a line of low-cost power tools put out by the American Machine & Tool Co. of Royersford, Pa.

They raise an intriguing question: Just how good can economy tools be? We decided to find out for ourselves. All three—the table saw, drill press, and jointer—were purchased by POPULAR SCIENCE and put through the same demanding jobs expected of other shop tools. The results were surprising.

Rugged but frill-less. What you get for your money is a combination of clever engineering and a stern lack of luxuries. There's no gleaming chrome, no fancy extras. Some parts are rough castings, some just pressed sheet metal—sturdy but plain.

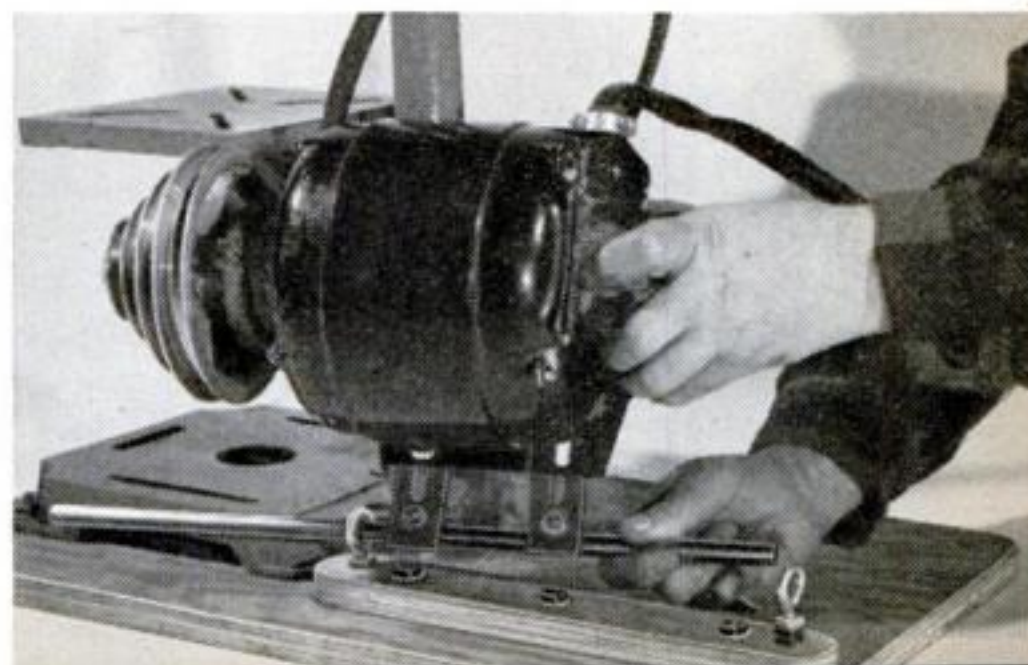
There are no depth or tilt scales except for one on the saw—you gauge settings with a rule and try square. Most adjustments are made by tightening or loosening bolts with a wrench instead of more convenient knobs. All bearings are simple bronze sleeves except in the drill press where they're a combination of sleeve and ball.

Despite the absence of frills, a good bit

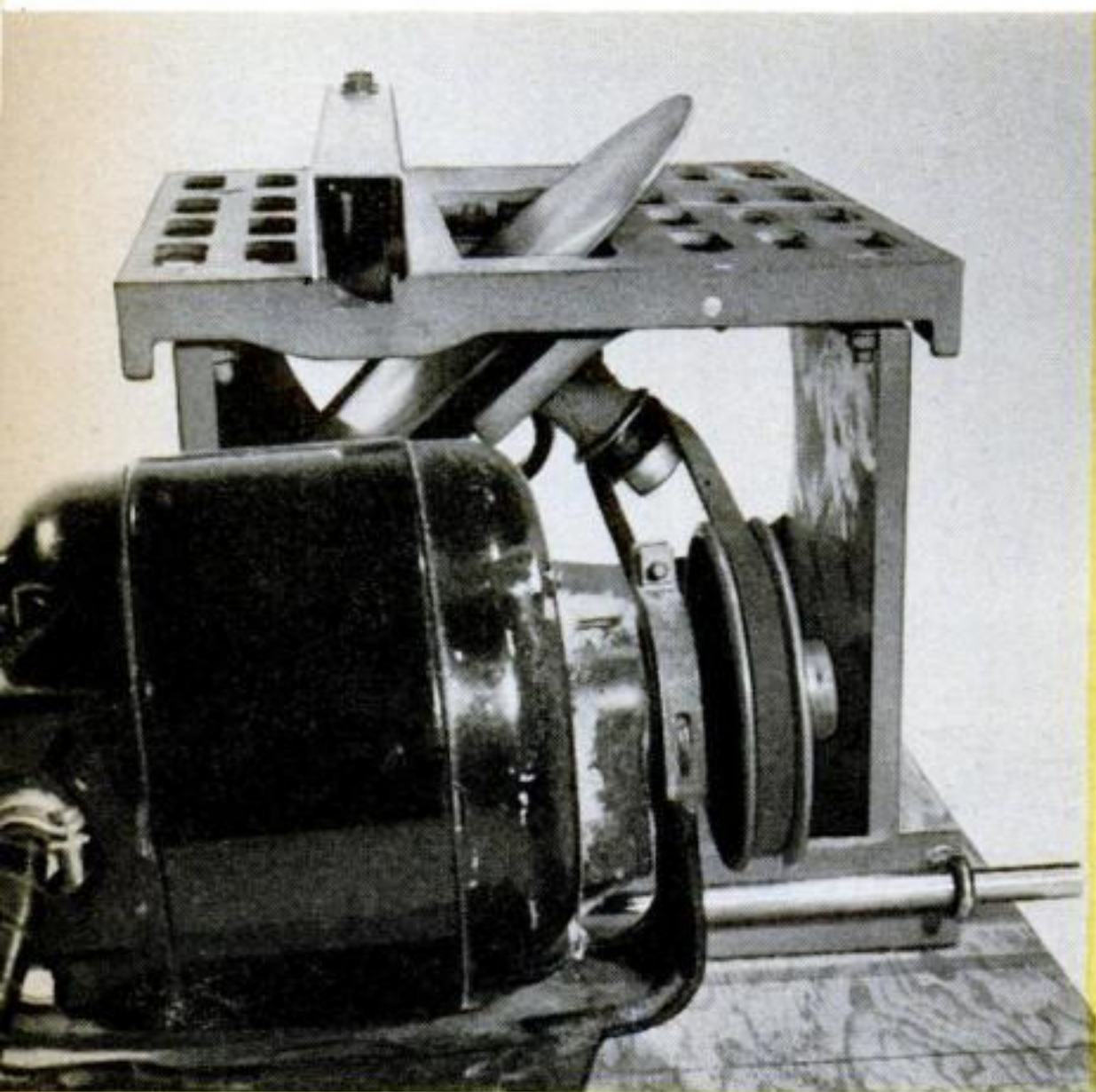


Homemade plywood table, a handy extra, can be fastened to the small drill-press table to increase its work area. Fitted with a fence, it turns the tool into an accurate drum sander.

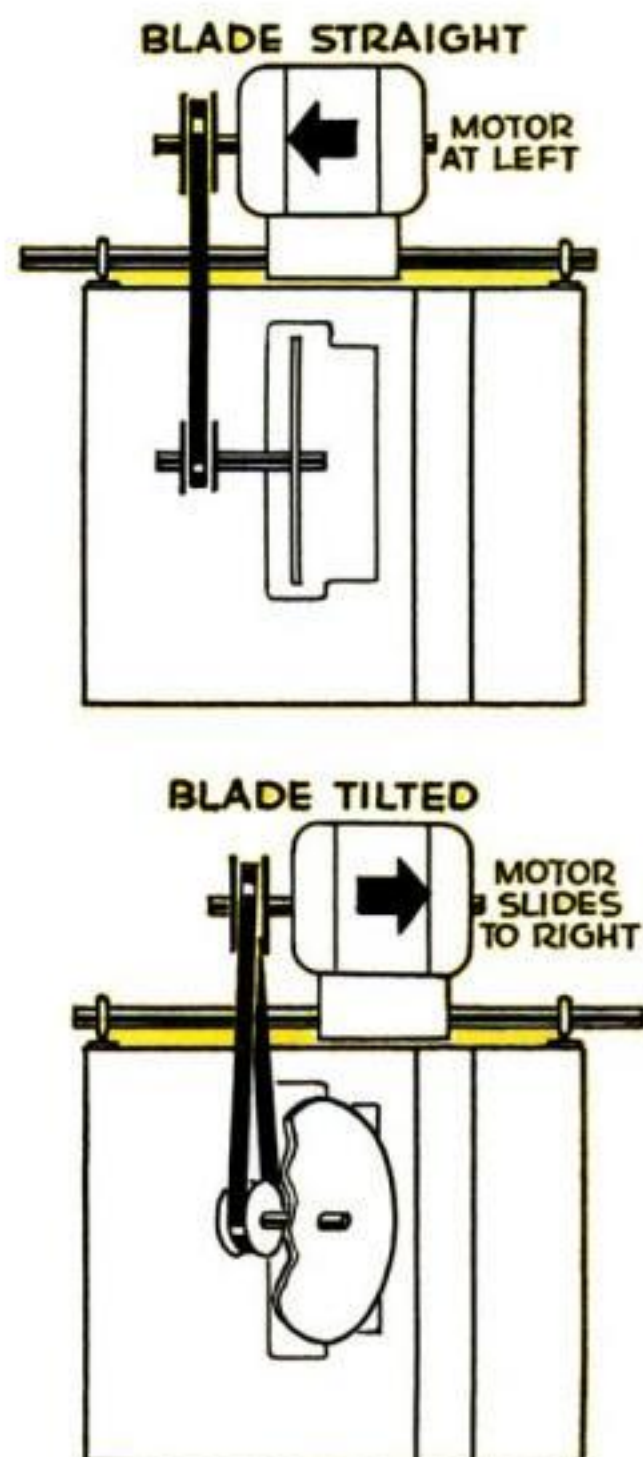
Floating motor mount is part of the table saw, but can be used on other tools to permit fast switching of the motor. Rod simply hooks into two eyebolts, shown here on the drill press.



How the saw's floating motor keeps belt lined up with blade



Motor hangs in back of the saw, instead of under it, allowing the whole works to fit on a flat, portable base. Mounted on a rod, the motor is held loosely in eyebolts that permit it to move in two directions. It tilts backward under its own weight to pull the belt taut. As the blade is tilted to make miter cuts, it also slides sideways in the eyebolts to keep the belt lined up with the shifting arbor pulley.



of sound—and imaginative—engineering has gone into the tools' design. One nice touch is a revolving table on the drill press, a feature generally found only on advanced machines. With this, you can clamp your work once and move it to any position without changing the setup.

The table saw, although small enough to tuck under your arm, swings an 8" blade—whopping for a tool of this size. It also has an unusual tilting arbor that's pivoted off-center. As you tilt the blade, the arbor actually rises to compensate for the normal loss in cutting depth.

Some adjustments are primitive but ingenious. Two nuts running up and down on a threaded rod in the drill press serve as an adjustable depth stop and spindle lock.

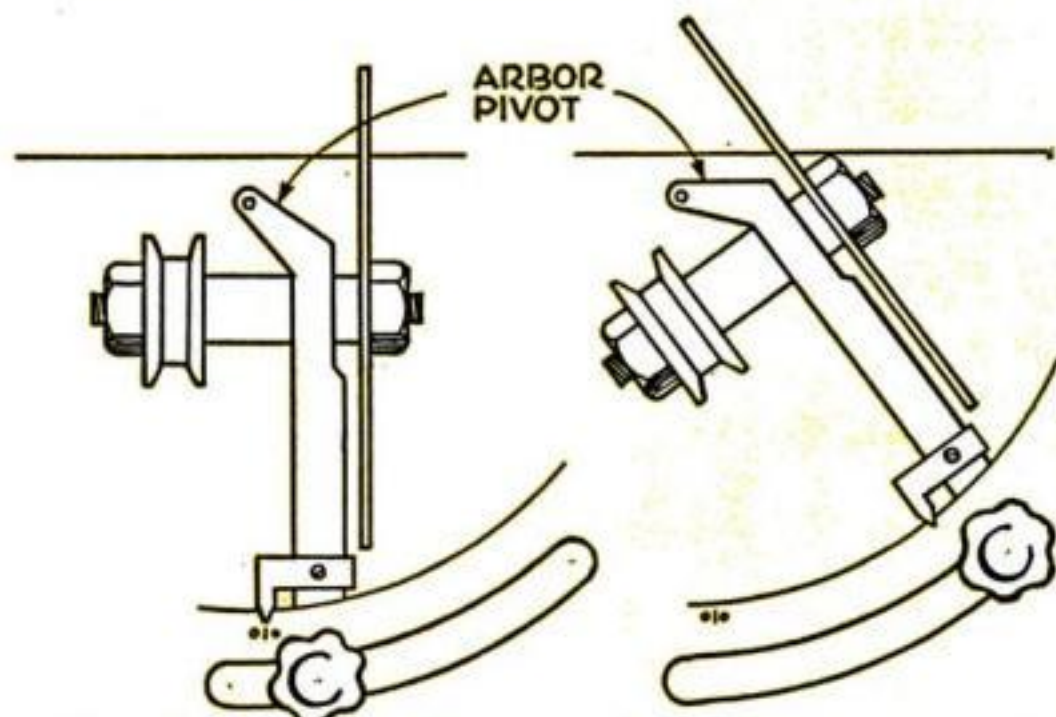
Three tools—one motor. You must supply your own motor to run the tools, but you

get a valuable bonus. The floating motor mount that comes with the table saw makes it easy to use a single motor with all three tools. The motor is clamped to a short rod that hooks into eyebolts on the saw. It takes only a minute to slip the motor out of the saw and transfer it to similar eyebolts near the drill press and jointer.

For test purposes, the tools were all mounted on identical 13"-by-23" plywood bases. This way, we could move them easily from one spot to another, store them on a shelf, or set them up one at a time as needed on a separate stand. Readily portable, the saw and jointer weigh only 19 pounds apiece, the drill press only 25.

Motors from $\frac{1}{4}$ hp. to $\frac{1}{2}$ hp. are recommended. We settled for $\frac{3}{8}$ hp.—in our opinion, minimal power for proper performance of these tools. For some jobs, you may

Why you can make deep miter cuts



You don't lose cutting depth on miters because the blade, ingeniously pivoted at the top, rises as it tilts. Test blocks at right show how cutting depth was further increased by enlarging the

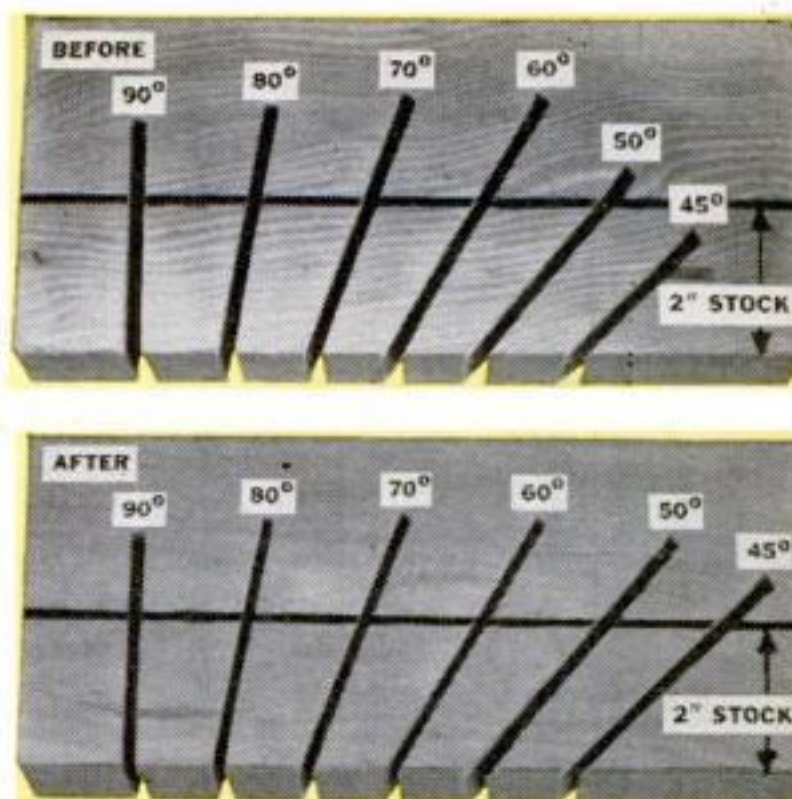
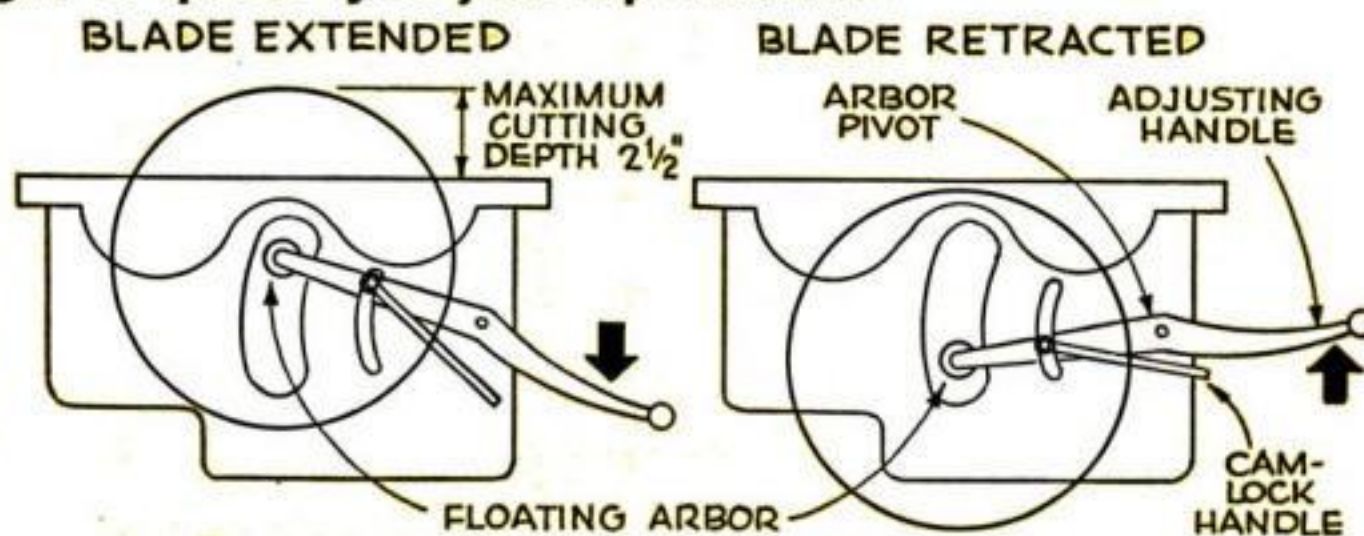


table slot to let the blade rise higher. In top block, blade was unable to cut 2" stock at 45 degrees, but did it easily after the slot was widened, as shown in the bottom block.

Setting blade height is quick—you just flip a handle

Simple height control works like a seesaw. Entire arbor, floating at the end of a handle, is raised or lowered by moving the handle down or up. A cam-action lever locks the handle at any height. Differences in belt length caused by the shifting arbor are taken up by the floating motor.



find $\frac{1}{2}$ hp. welcome. It's also helpful to have either a double-ended motor or one with a reversing switch. The reason: The drill press requires counterclockwise rotation; the saw, clockwise rotation. The jointer can be set up either way.

The drill press—a real honey. At first glance, this appears to be a curiously odd-ball contraption. Its drive belt—a long 58-incher—comes off the spindle pulley in a horizontal plane, does a 90-degree turn over two idler pulleys, then dips down vertically to the motor mounted below.

You soon discover, however, that the design is wonderfully simple, flexible, efficient, and economical all at the same time. There's no built-in speed changer because you don't need one. With the motor held in a floating mount, it's possible to obtain any of several speed ratios by simply

switching the drive belt to different positions on a multiple-step pulley.

We chose a four-step pulley providing diameters from 2" to 5" in 1" steps. With a 3" pulley on the drill press, this gives you a choice of speeds all the way from 1,150 r.p.m. at 2" up to nearly 3,000 r.p.m. at 5". The strange drive—really no stranger at all—is actually an age-old principle borrowed right from big industrial machines. It works like a charm.

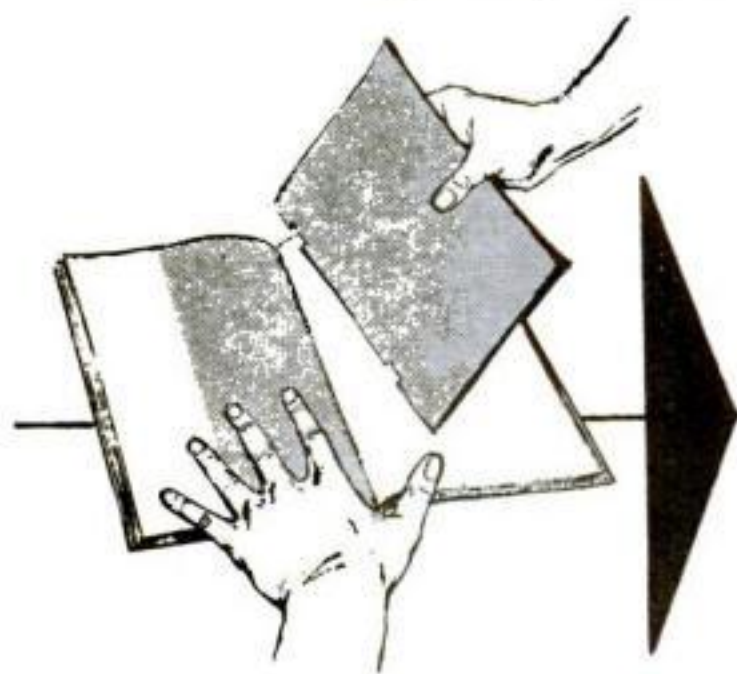
At 2,300 r.p.m., the tool drove a 1" spade bit through $\frac{3}{4}$ " pine in four seconds, $\frac{3}{4}$ " plywood in seven seconds, $\frac{3}{4}$ " maple in eight seconds, and 2" fir in 11 seconds. At a slower 1,150 r.p.m., it also made smooth, gleaming 1" holes in $\frac{3}{8}$ "-thick plastic in 25 seconds.

In metal, the little machine is even more

[\[Continued on page 182\]](#)

WHAT TO DO If Your Outboard Conks Out

By Harry Walton



To remove this SAVE-IT SECTION...

Pinch the following eight pages together (but don't include the one you are now reading). Carefully lift the end that's toward you (gently does it!), pulling steadily to free it from the lower staple through the magazine. Still lifting, tear the section free from the upper staple—and the magazine. Cover the rips at the edges with tape. Staple at the fold.





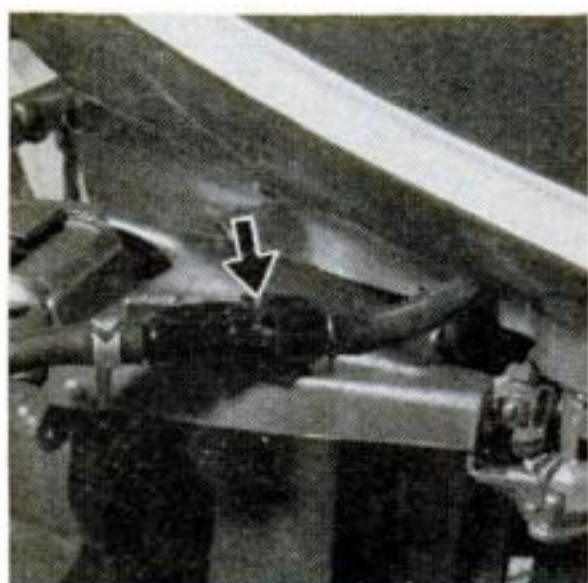
**Popular
Science**
Monthly
SAVE-IT-SECTION

Motor trouble? This fact-filled booklet tells you how to diagnose outboard ailments and how to cure them—to get you safely home. Store it in a handy place in your boat

Is gas line connected and tank vent open?



Beware of reversing the fuel line on Johnson and Evinrude motors. Unless the bulb end is at the tank, no gas will be delivered. See that the coupling is pushed on all the way, with its catch engaging the groove in the tank nipple, and depressing the vent pins (arrow).



Check motor end of the fuel line, too. If the coupling is pushed on only part way, as it is here, gas passages won't line up and the valve inside the coupling won't be opened.



Did you open the tank vent? On Mercury tanks and on one Scott tank, a screw-down air vent must be opened by hand. If you forget this, the motor may run briefly and stop.

TODAY'S outboards are almost monotonously reliable. Thousands of them roar along lustily for years of hard use. But that's cold comfort if your own motor misses, starts and quits, or won't even pop.

To check on what *does* go wrong with outboards, we interviewed a number of factory-trained service experts. To a man, they claimed that the commonest cause of trouble was carelessness: using vintage gas, mixing fuel and oil in the wrong proportions, failing to clean motors after use or to winterize them. They also bemoaned the outboarder who does everything right—until he plunks the full gas tank down on the hose, pinching off the fuel supply. His careless cousin is the guy who kinks the fuel line around some sharp corner—and cranks a gasless engine.

Assuming you've made no such blunder, what can you do if your motor won't so much as cough? You should, of course, know what's under the cowl. Your manual will tell you, and will give some elementary servicing advice. The troubleshooting pointers that follow, which apply to any two-cycle outboard except where specific brands are named, will take you further on the way to smooth performance.

The experts still swear by what Benz probably told Daimler: If there's gas *and* a spark in the cylinder, there has to be an explosion. Most servicemen check for gas first, saying that fuel failure is the commonest trouble. All agree on this: Don't change carburetor adjustments unless you *know* somebody has fiddled with them since the engine last ran. You may only compound your troubles.

Where's the gas? It's elementary that there must be gas in the tank, that with a remote fuel tank the hose must be connected at both ends and the system primed. Once the carburetor float valves shut, the primer bulb should become hard. If it does, you can check for gas in the carburetors or proceed with a spark test at once.

But if the bulb doesn't become hard, it's a fair assumption that gas isn't going where it should. Check the obvious things first: Is there gas in the tank? Is the gas line properly connected? Is it crushed, pinched, or kinked? Is the tank vent open?

On Johnson and Evinrude motors, make sure the bulb end of the line is coupled to the tank. If it's reversed, the primer won't pump gas. Both connections must be pushed on all the way, with the catch on each locked into its groove.

Fuel-line couplings for Mercury motors are not interchangeable, and on Scotts the fuel line is permanently connected at the motor end. But Mercury tanks, and that for the 14-hp. Scott, have screw-down air vents that must be opened. If a vent is left closed, priming may start the engine, but increasing tank vacuum will soon cut off the gas.

Fuel failure may also result from pinholes, cuts, or breaks in the gas line. If the primer bulb is between the break and tank, fuel will leak out. If the bulb is between motor and break, you may be pumping nothing but air.

If the motor end of the gas line is detachable, you can check right up to that point. Disconnect the line and, holding the coupling over the side, depress the valve inside it with a bit of wire or a cotter pin while pumping the bulb. If no gas spurts out, check the line, bulb, or tank.

If gas is being pumped but the bulb did not get hard with the line connected, inspect the short fuel lines between the coupling nipple, fuel pump, and carburetor. In a pinch you may be able to tape up a leaky line, or cut a piece out of the tank line as a replacement.

Checking the carburetor for gas is easy on Scott motors that have a drain valve at the bottom of the bowl. Press up the spring-loaded button, see if gas comes out, and then reprime. On other Scotts, watch the little vent hole in the side of the carburetor. Gas should come out as the engine is cranked with the choke closed. In Mercury engines, gas will dribble out of the carburetor air throats. On Johnsons and Evinrudes, remove the small drain screw low down on the carburetor. Gas should flow out of the bowl.

If there's water in the gas, visible as bubbles or blobs, empty the carburetor completely. Remove and dump the sediment bowl, if there is one, and wipe it dry. (Be careful not to damage the bowl gasket.) Badly contaminated gas can short spark plugs; remove them to blow and wipe the electrode ends dry. Pull the engine over a few turns by hand to blow water out of the cylinders. Pump the primer until delivered gas is free of water. Replace plugs and sediment bowl and reprime the system.

A common puzzler, service people say, is the motor that runs fine outbound; but spits, misses, or won't start for the return voyage. The reason: water in the spare gas can.

A **faulty primer** is rare, but a sticking or broken check valve can block one. On pressure-type tanks, gas leaking around the primer shaft is a sign of a bad diaphragm.

A clogged filter can be sneaky: It may make the bulb go hard yet send no gas to the carburetor. Dirty sintered-bronze filters may pass the gas you pump with the primer but block fuel fed under less pressure by the engine pump. (Another puzzler: The engine will start on primed gas but quit right away.) To correct, wipe out glass filter bowls and rinse filter elements in clean gas if possible. Blow sintered and ceramic filters clean from the inside out.

If a filter is **hopelessly clogged**, you can make port by removing the element. It's not recommended except in emergencies because dirt can plug the carburetor. A better dodge, if priming will push fuel through the clogged filter: Hand-pump gas until you can install a new element.

Be careful to seat filter bowls or covers properly and tighten clamp bolts firmly. Use fingers only—no tools—on glass-bowl clamps; overtightening can crack the bowl. A damaged gasket or a loose or misaligned bowl will let air leak in, preventing a suction-feed system from getting any fuel.

Engine-pump failure can be confused with ignition trouble, because the punctured diaphragm floods the cylinder it is mounted on, which doesn't fire. But it will usually continue pumping gas to the others to get you home.

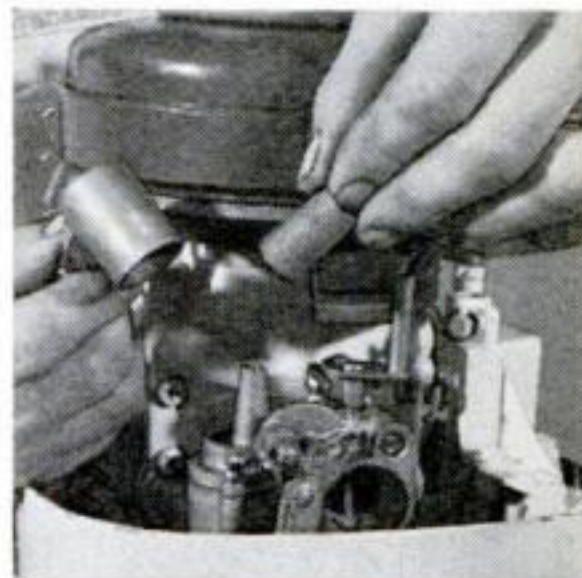
If fuel is getting to the carburetor and the choke is working right, there must be gas in the firing chambers—unless the carburetor jets have been closed or a reed valve is broken. The latter is rare. Don't assume carb settings are wrong (unless somebody has tampered with them); check ignition.

Testing for a spark is so easy that it may well be done before a complete fuel check. Pull a terminal cap off one

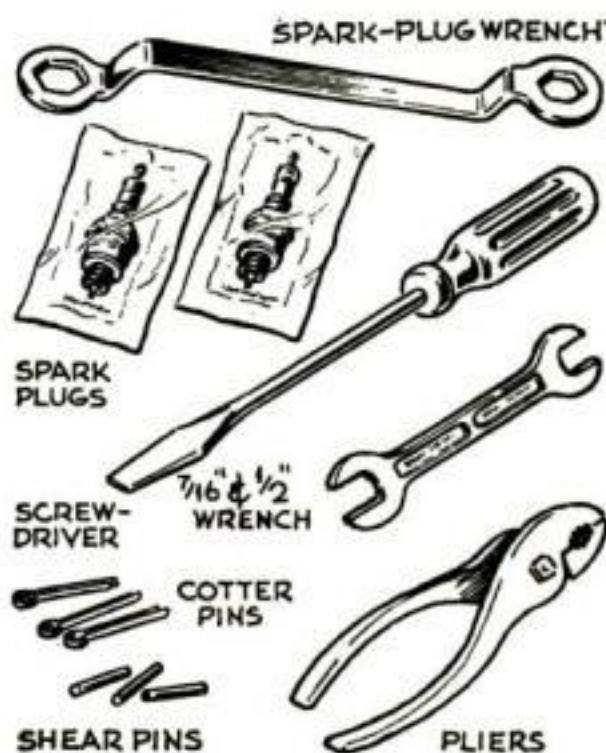
Check for line breaks and clogged filter



Inspect gas line for cracks. With a pressure-feed tank, check the air line too. Watch sharp bends at fittings (A). Gas coming out at plunger (B) is sign of a leaky primer.



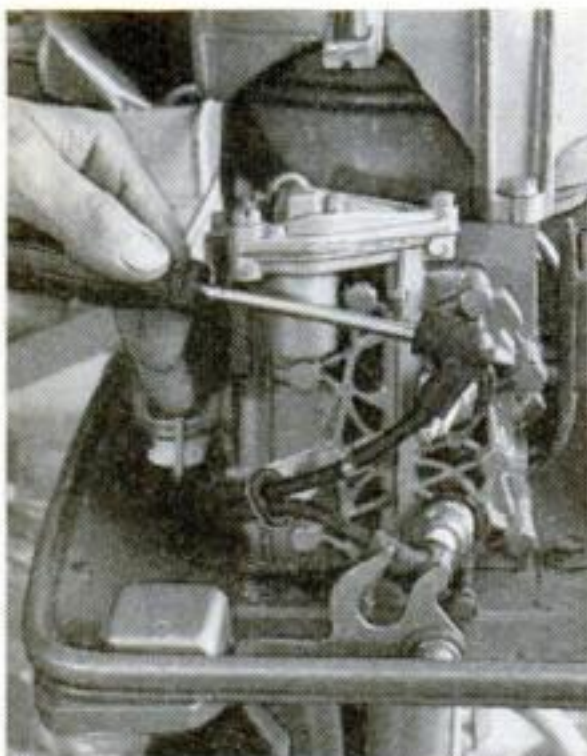
To clean Mercury filter, remove single bolt on top (take care not to lose sealing washer under it). Raise the filter cover as at left above, lift out filter, rinse it in clean gas, blow out.



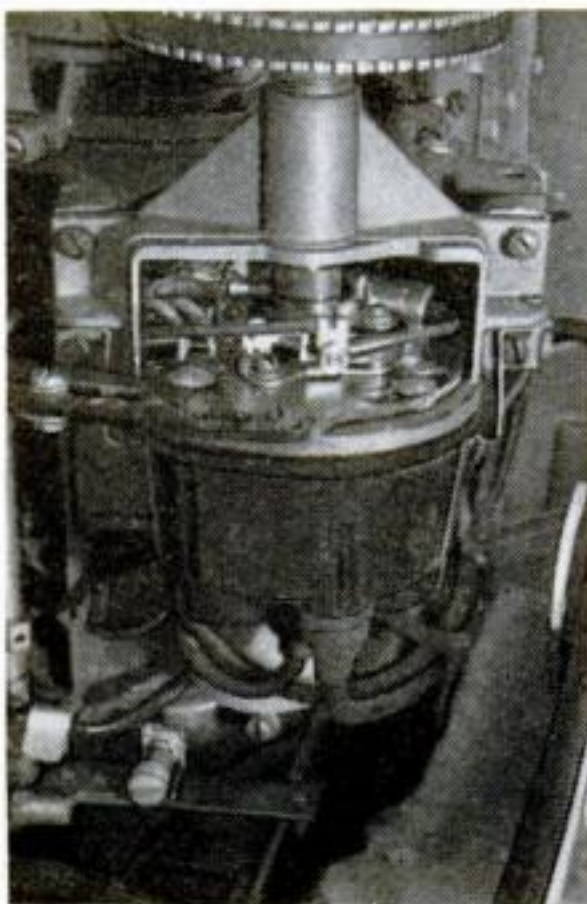
Your minimum tool kit should include above items. Keep spare spark plugs in their waterproof wrappers until needed. A roll of vinyl tape can be useful.

CONTINUED 113

Is there a hot spark to fire the fuel?



For a quick spark test, pull cable cap off one plug, insert screwdriver, hold shank $\frac{3}{16}$ " from engine metal. If spark is weak, check all high-tension wiring for insulation breaks, salt deposits, and moisture.



If you must check points on the 75-hp. Scott, remove screws and lift off distributor cover. But be wary of slipping off the timing belt (top of photo). If you do, you may find it impossible to retune the engine.

plug. Stick the blade of a plastic-handled screwdriver into it. Hold the shank about $\frac{3}{16}$ " from any metal motor part. On electric-start motors, be sure to turn on the ignition. Now crank the engine. If a blue-white spark jumps with an audible snap, the ignition system is good up to the plug.

It's easier to hand-crank if you remove the plugs (check them also). Reconnect the cable to its plug. Hold the plug body against the motor as you crank. If the spark across the plug gap is blue-white and snappy, ignition and plugs are okay. *Caution:* Make this test away from the plug holes; cranking blows out explosive vapor that sparks could fire.

Plugs can tell you more than the condition of the spark. If, after you've cranked the motor with the choke closed, the plug ends are completely dry, gas is not reaching the cylinders. But if the spark plugs are gas-soaked, the motor may be flooded. Shake and wipe the plugs dry. Clear the motor by turning it over a few times with plugs out and choke open.

If the plugs are water-wet, dry them and proceed the same way. If they're wet, but there is no water in the carburetor, it may be coming from the cooling jacket. This can result from improperly torqued head bolts. If leakage is confined to one cylinder, you may still be able to make port.

Trolling or idling for a long time, especially with too much oil in the gas, can carbonize plugs heavily, giving roughness and hard starting. If you have no spare plugs, scrape deposits off the electrodes with a small knife. Adjust the gap by bending the side electrode only; $\frac{1}{32}$ " is about right—or as near as you can get without a gap gauge.

Plug changes. If the insulators are cracked, rough, or blistered, or electrodes burned thin, you need new plugs. Use those specified for your motor. Don't substitute standard plugs for the new surface-gap type required in some Scott motors. These need no adjustment and wipe clean.

Clean grit off the seat and gasket when replacing plugs. Wipe excess oil off the threads to insure a good electrical ground. Tighten plugs securely.

Push each cable cap firmly onto the plug terminal. See that the cable is shoved all the way into the cap. Be careful to replace each cable on its proper plug. If cables are cross-connected, you'll get occasional backfires, but the motor won't run. If cables are not marked, their relative lengths and positions may serve as clues.

If there is no spark, check the high-tension cables for cracks and pinholes (you may spot them by cranking and looking for errant sparks). Wash off salt deposits with fresh water and wipe the wiring dry.

Cracked insulation may leak current where a wire touches metal. Tying a cable away from such parts may bring a motor back to life. Insulation-puncturing spark testers leave holes from which spark current leaps to any nearby ground.

If the spark is yellowish instead of blue-white, with little or no snap, it may not jump at all under compression. Try another plug before deciding the electrical system is at fault. Check also for defective insulation and salt deposits. Wipe dry wiring, plug caps, and distributor. If these steps produce no better spark, you may have maladjusted ignition points or a defective coil or condenser.

On most Scotts and Mercurys, point adjustment is best left

to service stations because the flywheel must be removed. (Trying this without a wheel puller risks damage to the shaft and bearings.) On the three-cylinder 75-hp. Scott, which has battery ignition, removing four bolts under the timing pulley exposes the points, as shown in a photo.

On Evinrude and Johnson powerheads (except 1962 40-hp. models) you can remove the rewind mechanisms on top of the flywheel by taking out three bolts. Under a small plate on the flywheel is a hole through which you can see each of two sets of points just as they open.

If they are not opening when the hole is in line, they are badly out of adjustment, or the fixed point is loose, or the flywheel key has sheared. In this last case, the only fix is to pull the flywheel and install a new key.

Don't try to readjust points away from the shop unless they are grossly maladjusted. If you must, a strip torn from a matchbook cover will serve as a crude thickness gauge. Be sure to set the gap with the points at maximum openings, and tighten the lock screw securely.

Safety interlocks can cause puzzling failures. Electric-starting Johnsons and Evinrudes of 35 hp. and more have a microswitch that cuts out the starter solenoid if the throttle is advanced beyond its proper starting position. Sometimes the switch shifts enough to cut out prematurely. Merely retarding the throttle a trifle may release it and restore normal cranking until the switch can be readjusted.

Magneto-ignition motors of these makes have mechanical linkage that locks the pull starter if the throttle is over-advanced. See that the linkage isn't bent, damaged, or out of adjustment if the engine can't be cranked.

Four-cylinder Mercurys can be started in gear; sixes cannot. Owners who graduate from a four to a six sometimes forget the difference. Mercurys of 50 hp. and up have a mercury tilt switch that shorts ignition when the motor is raised. Sometimes amalgam deposits inside the switch can short it out while untilted. If you get no spark, disconnect the grounding wire to this switch, as shown in a photograph, or remove the tilt-switch and stop-switch wires at the mag.

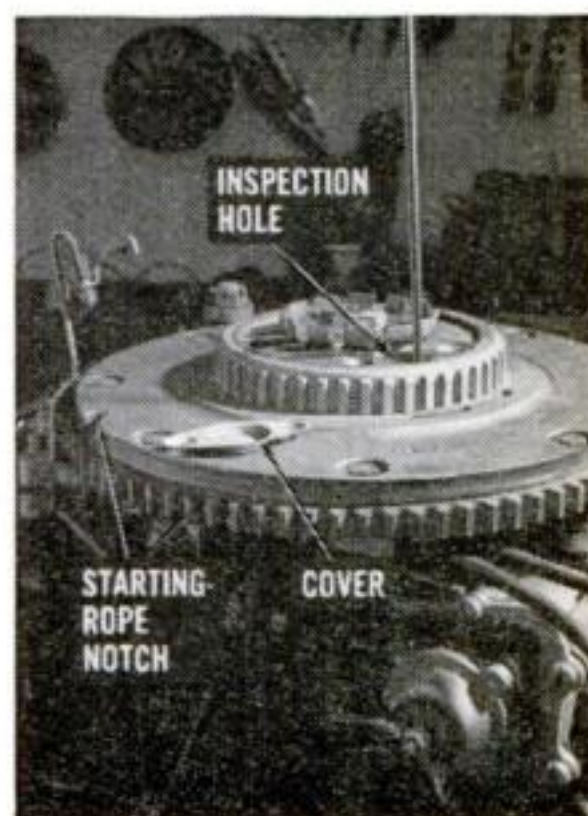
Having dual-ignition systems, 75- and 100-hp. Mercury sixes have two leads from the terminal block on the port side to the tilt switch. Disconnect both if a switch short is suspected. Mercury twins of six to 25 hp. have a stop switch on the cowl housing. Disconnect two yellow wires at the terminal block to check out the switch.

If an electric starter fails, first see if the battery connections are clean and tight. A weak battery or poor connection may click the starter solenoid but lack punch to run the starter. If turning on the key results in dead silence, the solenoid circuit may be at fault. If so, you can short the two heavy solenoid terminals to close the starter circuit. If the starter whirs but doesn't crank, the pinion is probably stuck.

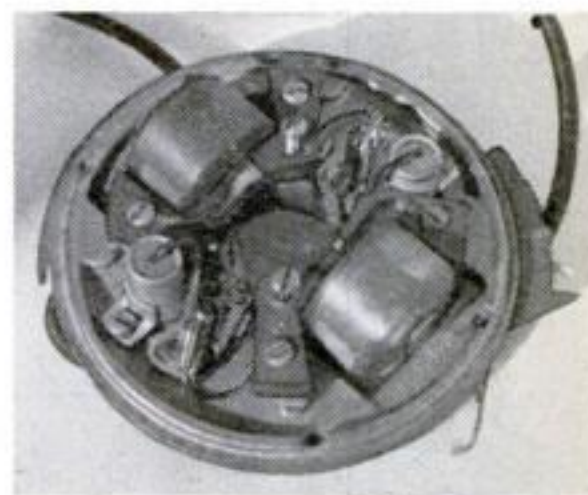
Don't crank electric starters more than five seconds at a time. After 30 seconds of intermittent cranking, let the starter cool for two minutes. Reason: These compact motors get very hot and may burn out under prolonged cranking.

If the battery's dead or the starter inoperable—start manually. Most motors have rewind starters built in. Should the ratchet be defective or the rope break, you can *still* get going.

Adjust points only if they are badly out

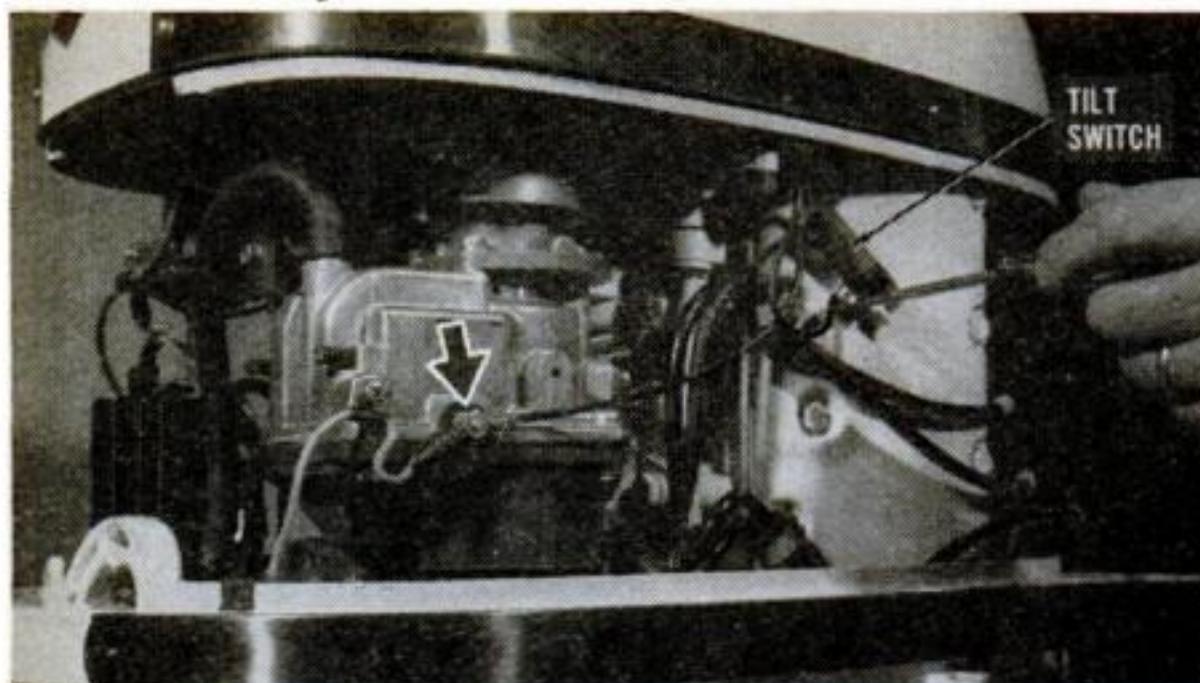


Remove three bolts and lift off the rewind drum of Johnson and Evinrude magneto-ignition motors to expose a plate covering a hole in the flywheel. Through this, points can be inspected and adjusted as above.

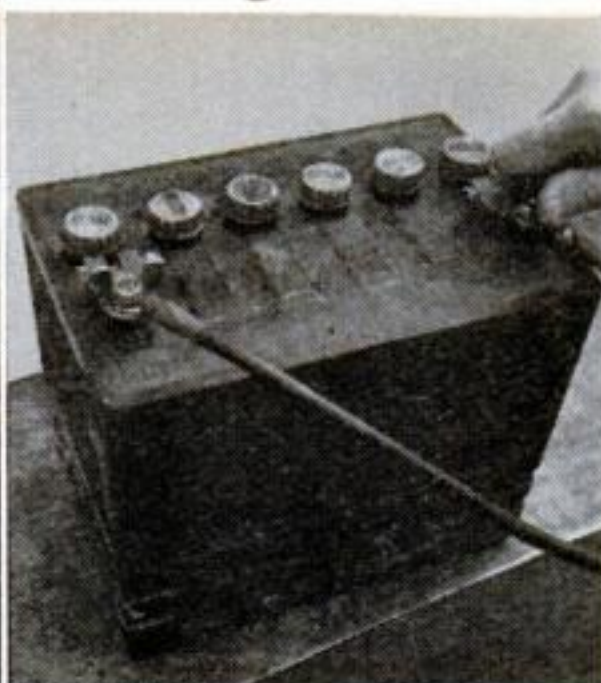


Under the flywheel (of motor above) is a dual-ignition system like this. Inspection hole reveals each set of points just as they open. Loosen lock screw, adjust gap with other screw, retighten lock screw.

Check safety switches and batteries on electric-starting models



Defective tilt switch can kill ignition in 50-hp. and larger Mercurys. For easy check, detach ground wire (above, right) or take both wires off magneto terminal (arrow), thus checking stop-switch circuit also. On the 75- and 100-hp. motors, detach two tilt-switch wires at terminal block.



Loose or dirty connections can make a battery play dead. Clean posts and cable lugs, tighten terminal nuts firmly, and apply grease to halt corrosion.

On Scott motors, remove the three bolts that hold on the recoil-starter cover. If you carry no spare rope, take it off the rewind drum, knot an end, and hook it into the notch in the flywheel groove.

Remove the flywheel cover to expose the starting-rope groove on Evinrudes and Johnsons. Six- and 10-hp. Mercurys can be cranked by putting the palms of the hands on opposite sides of the flywheel and spinning it clockwise, but keep your fingers out of the ratchet ring.

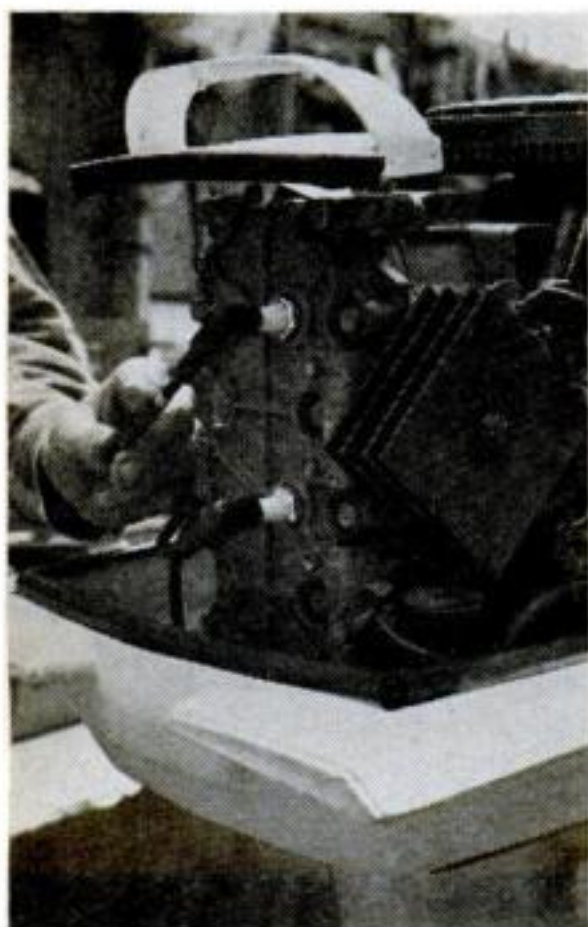
Carburetor adjustments must be made with the boat in the water and the engine warm. A competent pilot should be at the remote controls while you're at the engine.

Turn the low- and high-speed screws on the carburetor gently clockwise until the needle points seat (never force them shut). On Johnsons and Evinrudes, back off both screws $1\frac{1}{2}$ turns. The motor should start. Warm it up and get under way at full throttle. Turn the high-speed setting clockwise until the motor begins to lose speed; then back it out just enough to restore full power.

Next, idle the engine while still in forward gear. Turn the idle adjustment counterclockwise until the motor begins to gallop or run unevenly, then clockwise until the motor starts to spit. Finally, back it out again to restore smooth running, somewhere between the two extremes. Then try accelerating. If the motor falters, turn the high-speed screw counterclockwise a trifle.

Most Mercury and Scott motors have fixed high-speed jets. Starting setting for the low-speed screw is one turn out from the closed position. A slightly rich (counterclockwise) idle is preferable to a lean one.

Overheating is first evident by a loss of power and boat speed. If it continues without correction, the motor may seize—stop suddenly because friction halts heat-expanded parts. The cause may be too little oil, a maladjusted carburetor, weeds or a bit of paper clogging the cooling-water intake. Cooling may also fail if the motor is mounted so high on the transom that the water intake is not submerged.



Have you connected spark-plug leads to the right plugs? The motor cannot run right if they are switched. An easy mistake to make even on twins, it results in violent backfires.

In rarer cases, the intake is too near the keel, and cavitation may cause both air and water to be drawn in.

See that the cooling-water intake screen is unclogged. It can sometimes be cleared by running briefly in reverse. The reverse flow around the lower unit may wash off the obstructing matter. If the motor has seized, let it cool at least 15 minutes. Then, if the cause has been corrected and the motor can be cranked freely, it should run again.

If the motor runs well until hot, then slows and loses power even though cooling water circulates normally, pre-ignition due to lead deposits on the plugs is likely. A secondary cause of pre-ignition is carbon on the piston head and in the firing chamber. Install new plugs and, if possible, squirt a good engine cleaner directly into the carburetor. Use unleaded gas to cut down lead fouling.

If your motor falls overboard, have it serviced as soon as possible. Wash off mud and silt. Remove the spark plugs, and crank it over, plug holes down, to remove as much water as possible. Crank by hand, and don't force it if it doesn't turn over freely; a piston may be broken or a rod bent.

Pour about two ounces of alcohol or engine cleaner in each plug hole and crank briefly to distribute it. If neither cleaner is on hand, squirt in a little fuel by depressing the valve in the line coupling as you work the primer. Get the motor to your dealer as soon as possible. If it fell into salt water, but you cannot get it serviced promptly, leave it in the water or drop it upside down in fresh water until servicing.

A *knocking engine* may be laboring under pre-ignition. But the knock may also be in the lower unit instead. To check, pull off the plug terminals for safety and slowly turn the prop by hand. You'll feel any tooth damage in the lower unit. Clutch damage may result, incidentally, from the habit of over-timid shifting into forward or reverse. Throttle the motor back and shift quickly to engage the clutch dogs with a minimum of wear.

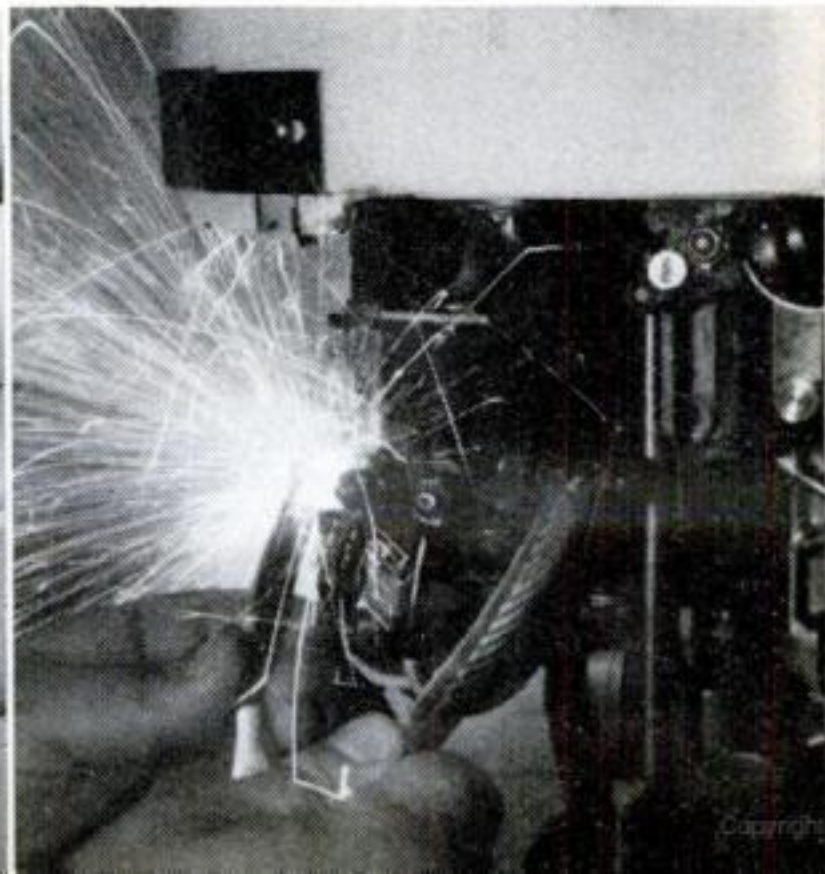
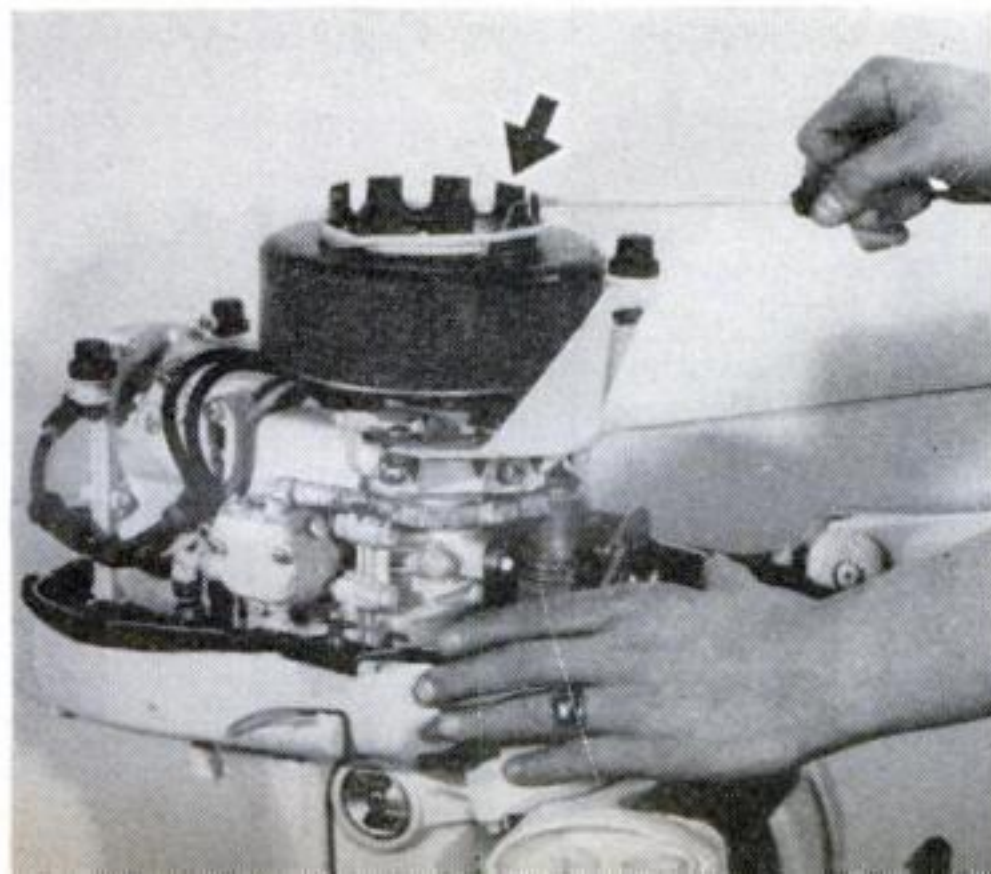
Recoil starter damaged? You can start some engines by winding the rope on a flywheel groove. On 10- to 25-hp. Mercury motors like the one below, one starter notch has a sloping side. The rope knot holds against the opposite straight side for cranking, then slips off the slope when the engine catches.

If a starter solenoid fails to close, you can bridge its heavy terminals (to which the thick cables are connected) and so energize the starter directly. Touch opened pliers firmly to both nuts—not the bolts—to avoid arc spatter on threads. Sparks will fly, so clean up any spilled gas before using this dodge.

Golden Rules

FROM OUTBOARD REPAIR EXPERTS

- Remember that motor, prop, and hull are a team—don't mismatch them when changing one or the other.
- Discard any gas-and-oil mix that has been around more than a few weeks.
- Don't mount your motor too high or tilt it up too far.
- Don't be slapdash about the proportions of gas and oil for your motor.
- Keep an eye on the cooling-water outlet in weedy or debris-filled water.
- Carry extra spark plugs—they are the spare parts you need most often.
- Clean and winterize your motor before storing it at the end of the season.



Quick-Check Chart

MOTOR TROUBLES AND THEIR CAUSES

ENGINE WON'T FIRE

CLUE	POSSIBLE CAUSE
Primer bulb does not become firm when pumped	Fuel tank empty Fuel tank on gas line Fuel line reversed Fuel connections not secure Fuel line pinched or kinked Tank vent closed Break in fuel line Defective primer
Primer bulb hard but no fuel at carburetor	Clogged filter Fuel-line valve not opening Defective primer.
Fuel in carburetor but plugs stay dry	Choke not closing Idling jet shut Defective reed valve
Plugs wet with gasoline	Engine flooded
Water on spark plugs	Water in gasoline Cooling water leaking into cylinder
Spark weak, short, or yellowish	Cracks or pinholes in high-tension-cable insulation Cables not pushed fully into terminal caps Water or salt deposits on high-tension wiring Breaker points maladjusted Points pitted or burned Coil or condenser faulty
Spark at terminal caps but not across plug gaps	Fouled spark plugs Defective spark plugs Plug gap too wide Cables not pushed fully into terminal caps Defective, burned, or damaged spark plugs
No spark at terminal caps	Cables not pushed in fully Short circuit in tilt switch, stop switch, or their wiring Cracked cable insulation Breaker points maladjusted, pitted, or burned Coil or condenser faulty Flywheel key sheared
Gas and spark check okay	Terminal caps on wrong spark plugs

ENGINE STARTS, RUNS BRIEFLY, STOPS

CLUE	POSSIBLE CAUSE
Restarts after short wait and repriming	Fuel tank empty Fuel line not connected or secure Tank vent closed Fuel filter clogged Fuel line pinched or kinked Air leak in fuel system Weak spark Intermittent ignition fault

ENGINE SPITS BUT WON'T START, BACKFIRES, RUNS ROUGH, OR WON'T IDLE

CLUE	POSSIBLE CAUSE
Operated all right on first tank of fuel	Fouled or defective plugs Water in gas Water in spare tank
Runs steadily on open throttle	Idling jet closed too far
Floods	Choke not opening
Runs irregularly	Fuel filter partly clogged Fuel line pinched Air leak in fuel system Fuel-pump defective Stale gas or wrong fuel Too much oil in fuel
Won't run, but backfires	Terminal caps on wrong plugs Breaker points maladjusted, pitted, or burned

ENGINE LACKS POWER, OVERHEATS

CLUE	POSSIBLE CAUSE
Ran well until warm	Pre-ignition due to carbon deposits and/or lead-fouled plugs
New prop used	Prop pitch too great
Answers throttle poorly	Mixture too lean Fuel line pinched Fuel filter partly clogged Air leak in fuel system Fuel pump defective Stale gas or wrong fuel Too much oil in gas Plugs fouled or defective Weak or intermittent spark
No water from exhaust relief outlet	Water pump defective Water inlet clogged

STARTER WON'T CRANK ENGINE

CLUE	POSSIBLE CAUSE
Pull-handle locked	Interlock defective
Electric starter inoperative	Interlock switch maladjusted Solenoid circuit open
Solenoid clicks, but starter doesn't operate	Battery weak Loose or corroded connections Starter burned out
Starter spins	Pinion stuck

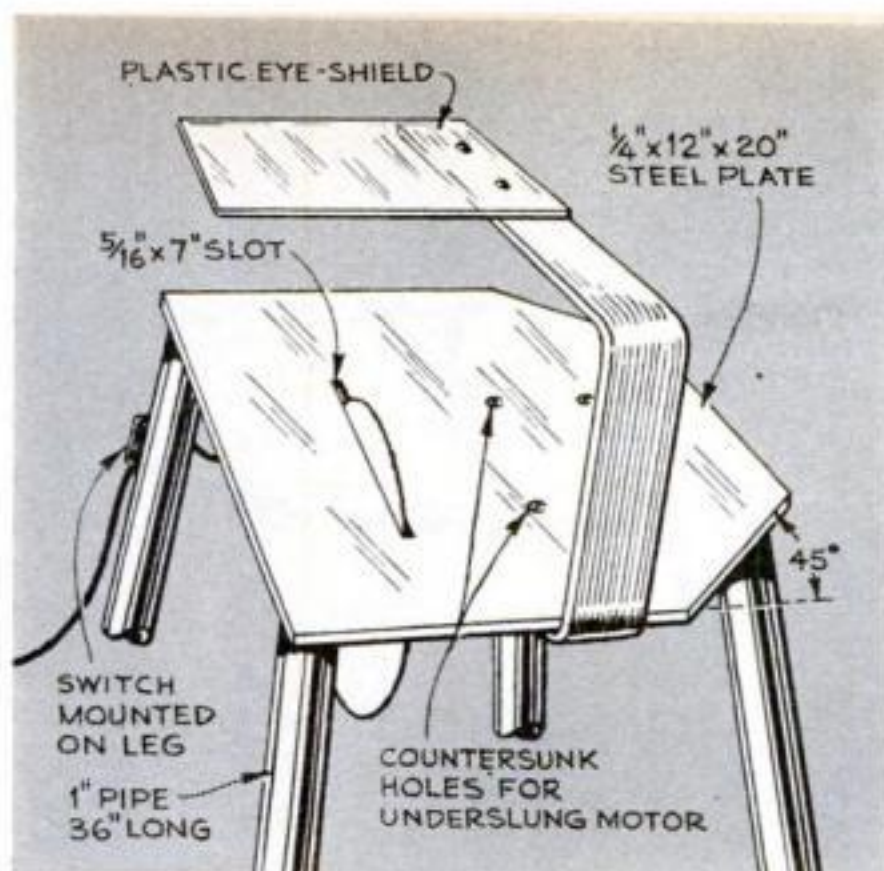
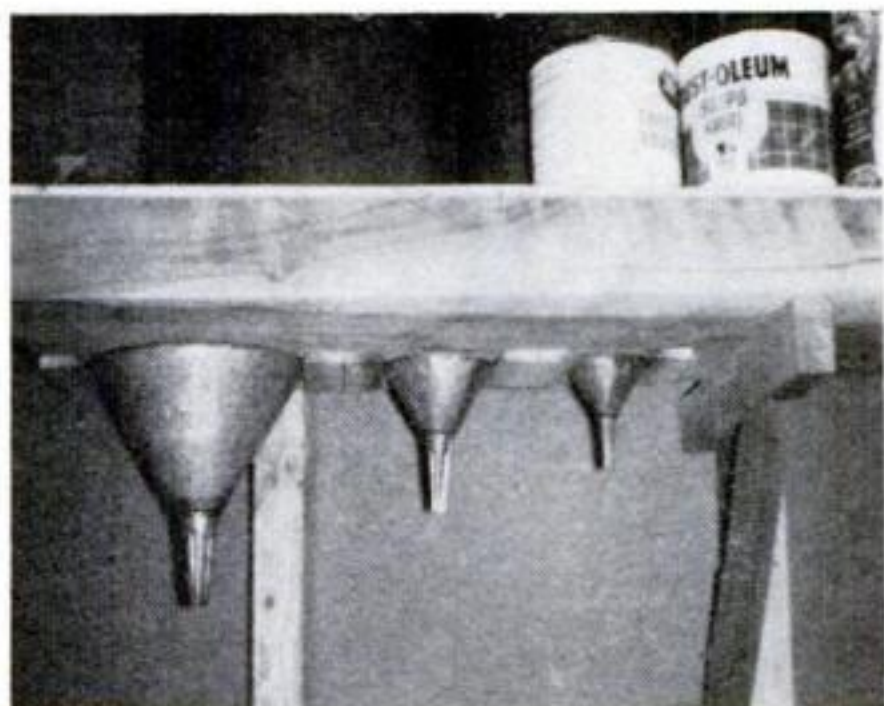


Table saw for metal cutting

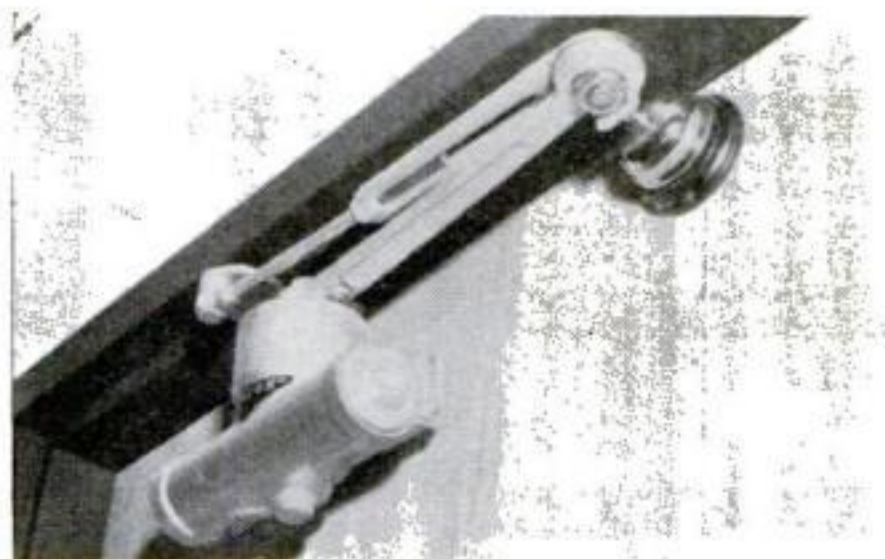
Here's a simple platform saw for cutting pipe, tubing, and light plate. In a piece of $\frac{1}{4}$ " steel, make a slot long enough to pass an inch or so of an 8" abrasive wheel. Weld on four pipe legs and bolt on a $\frac{1}{4}$ -hp. motor with a standard $\frac{1}{2}$ " shaft adapter. For safety add a bracket to hold a transparent plastic sheet over the wheel.—*D. Lathrop, Saguaro Nat'l Monument, Ariz.*

►►►Ever try to remove old wallpaper that had been coated with latex paint? A steamer won't budge it, since the paint acts as a seal. I cut a piece of tin to the size of the plate of my orbital sander and punched



Under-shelf funnel storage

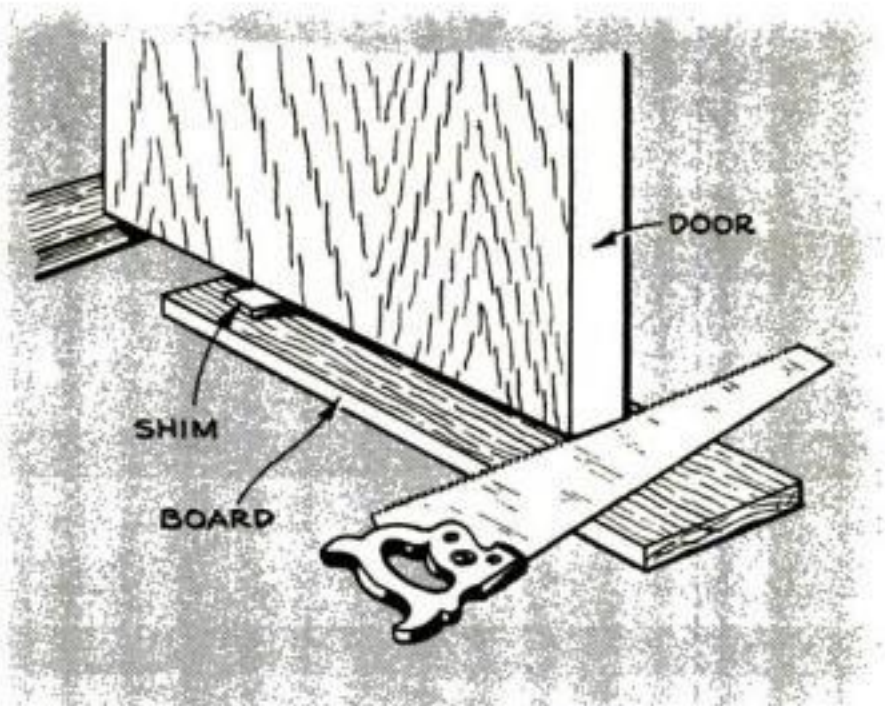
When you hang funnels from nails, the spouts stick out to gouge you. I nailed blocks under a shelf so their beveled edges would form a trough the funnels would slip into. This keeps them free of dust, too.—*W. F. Chaple, Oklahoma City, Okla.*



Door-mounted bell announces callers

Want a signal to tell you someone's entered your shop while you're in the next room? Here's a bell that'll work on any door equipped with an automatic closer of the type shown. I mounted a desk bell so that the pivot arm of the closer would strike the button as the door shut. For better contact, I glued a cardboard plate to the arm.—*Bob Schmidt, Fond du Lac, Wis.*

it full of nailholes until it looked like a potato grater. With this on the sander, roughening the wall was easy. And once the film was scratched, the steamer worked fine.—*H. W. Hausmann, Weymouth, Mass.*



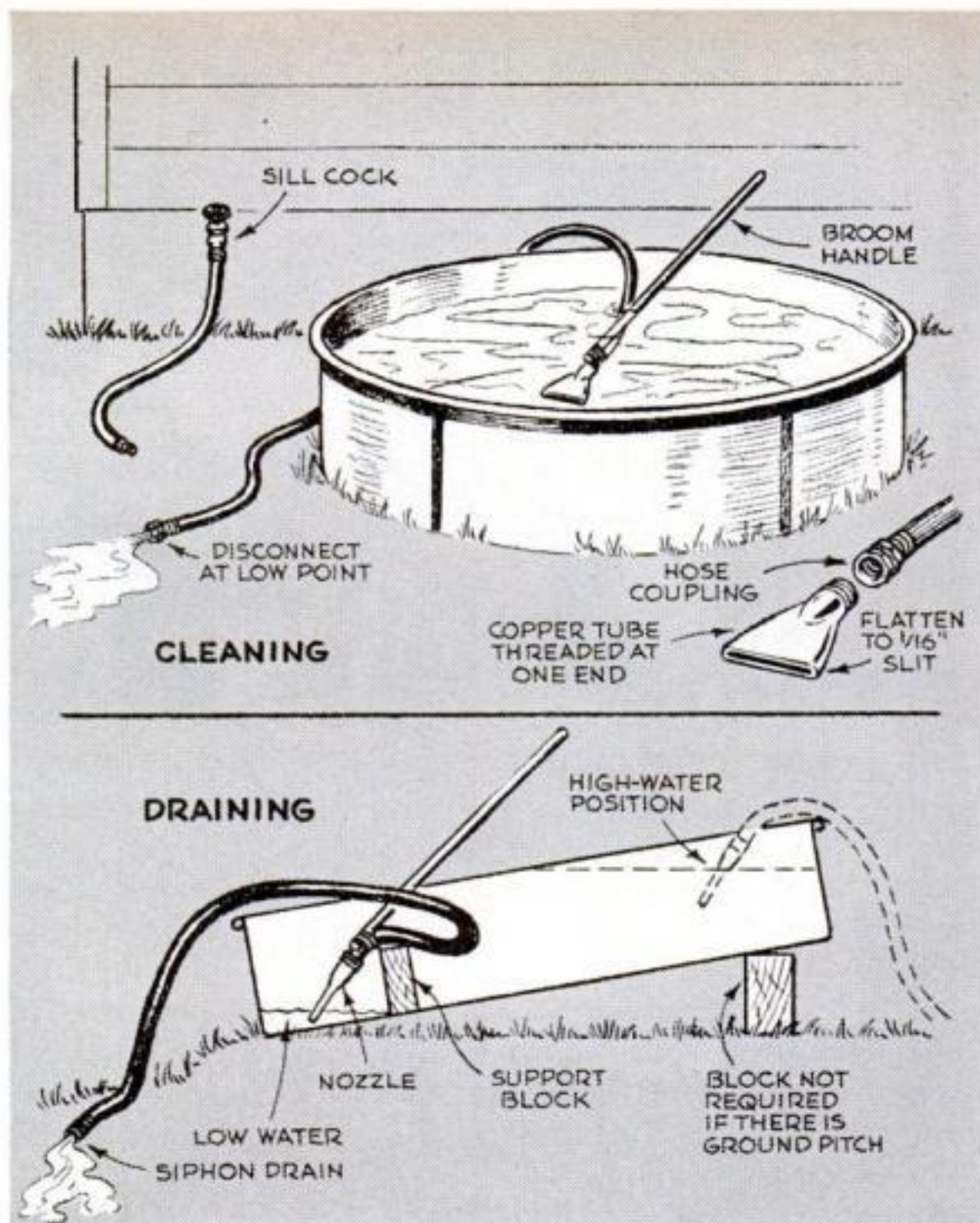
When a door binds on the sill

You needn't take a sticking door off its hinges to trim the bottom. Just open it, wedge a board underneath, and lay a saw flat against the board to make the cut. If you want a taper, saw toward a cardboard shim.—*R. H. Etten, St. Paul, Minn.*

Vacuum cleaner for plastic swimming pools

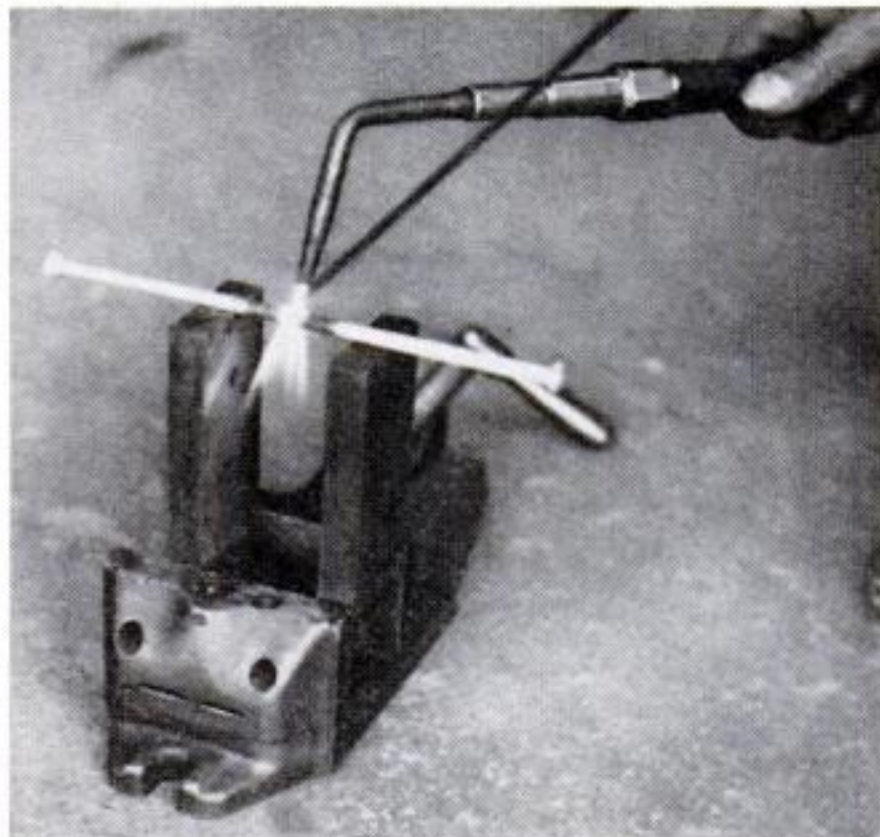
Sediment can be siphoned from a portable pool without changing the water. Just screw a homemade nozzle on a garden hose, connect the hose to a faucet, and place the nozzle on the pool bottom. Turn on the water until the nozzle stops spitting bubbles, then shut it off and disconnect the hose. This creates strong suction at the nozzle; move it around to pick up deposits, suspended particles—even surface scum.

The same siphon action can be used to drain the pool, with additional hoses to distribute the water around the yard.—*Herman H. Immohr, Queens Village, N. Y.*



Removing stubborn sanding sleeves

To remove worn sanding sleeves from a drum of stacked rubber washers, I chuck the drum in my drill press, loosen the nut a few turns, flip the switch, and force a block of wood against the top edge. The sleeve crawls away from the pressure. I cut the power and slip it the rest of the way off the drum.—*C. B. Ohman, San Diego.*



Magnet holds small parts for welding

No welder should ever throw away a magnet, because it can be handy to align small parts, positioned at any required angle. I clamp the horseshoe type in a vise, as shown. But you can also hold them upright by fitting them with a baseplate. Just drill and tap two holes.—*Dean Merrill, Ripley, Okla.*

How to Locate and Dig Your Own Pond

By Craig Edwards



HOW would you like to have your own private body of water—a small pond? Lots of people do. I have been in the pond-building business in Connecticut since 1949, and I can tell you that ponds are becoming more popular every year.

Naturally, you need a bit of space. Beyond that, you need a soil that's tight enough to hold water and a watershed large enough to keep the pond full.

The ideal pond site is one that shows signs of being moist when everything else is drying up. Plants—sedges, wild flags, cattails—are often indicators. Many of the better spots are found at the base of slopes.

Dig test holes in any site that looks promising, using a post-hole digger or shovel. Get down to the depth of the proposed pond. Usually six feet is enough.

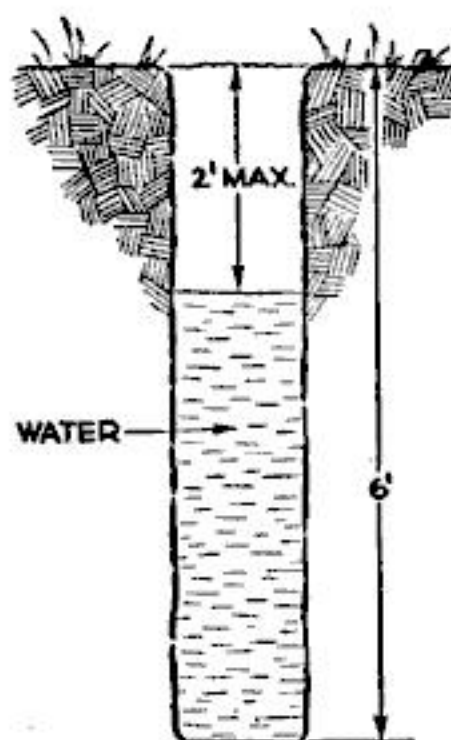
If the soil is tight enough to support a pond, moisture will appear in the hole by the time you have dug four feet. The soil must be tight

at the level of the pond bottom, too. (In many cases a compact soil will continue down for many feet.) Many ponds go dry each summer because of a gravel or sandy bottom. A ball of soil that hardens when dried is usually a good bet to hold water.

The watershed is the area of land sloping toward the pond site. If soil conditions in the pond site are favorable, a 10-acre watershed will generally keep a one-acre pond full.

Where the watershed is very small, you can determine the feasibility of a pond by checking the water level in test holes during the summer. The level will behave much as the surface of a pond in the area would. Go ahead with your pond if the water in the holes drops no more than two feet below the ground surface.

Ponds can be dug at any season, but summer is usually the most economical time. Sites are at their driest and more dirt can be moved per hour. The equipment most often used is the bulldozer



Can you have a pond? A test hole dug in a wet spot will show. Go ahead with the pond if the water level in the hole doesn't drop more than 24" from the ground surface in the dry months.

or the dragline shovel. Most small ponds require the use of only one of these.

Costs vary according to location. A dozer may rent for \$12 to \$14 an hour and the dragline \$14 to \$16 an hour. A dozer is generally used on a site with a tight soil and a watershed of 10 acres or less. In August these sites are dry and a pond will fill up rapidly as the fall rains occur. Hire a 12-ton dozer. A smaller one is false economy.

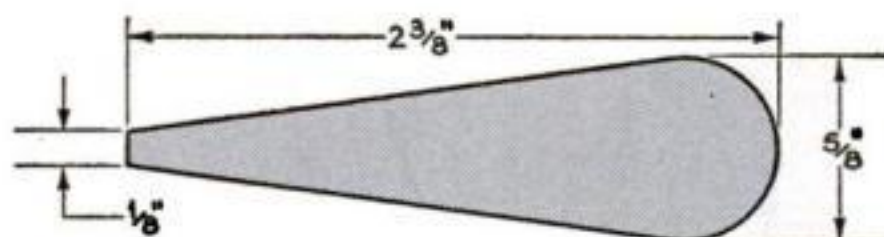
When the site has a large watershed, it is generally too wet in August for a bulldozer. Here is the spot for the dragline. Hire one that has a $\frac{3}{4}$ -cubic-yard bucket and a 40- or 50-foot boom. An experienced operator can reach and control his bucket five feet beyond his boom. Hence a machine with a 50-foot boom can dig a pond 55 feet wide by moving along one side.

If water seeps in during construction, keep a pump going. Don't try to dig in

the water. You will get a better pond and usually a cheaper one using a pump. It's far more efficient at moving water than the dragline. Try to spread the excavated material around the pond edges. Allow water to leave the pond over ground that has not been disturbed. A 10-foot gap left in the fill can serve as this outlet. Grade the fill material so that it does not block the flow of water into the pond.

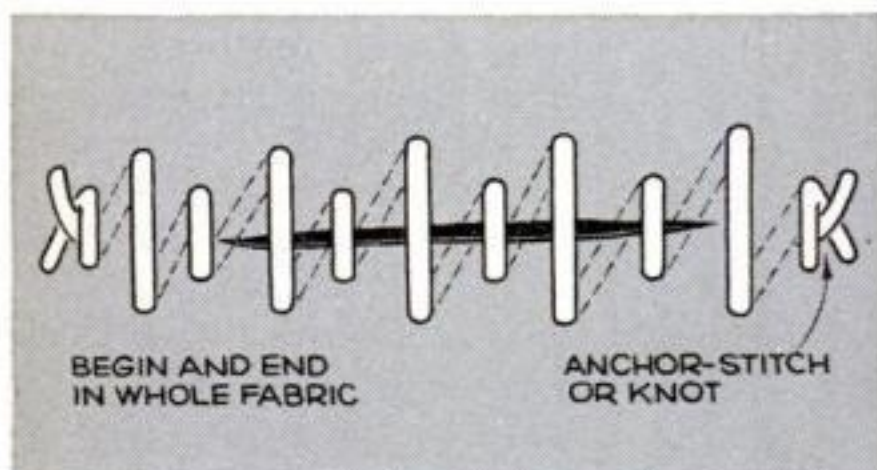
Six feet is a good depth. Shallower ponds usually end up full of aquatic vegetation. Side slopes of 2:1 are desirable on all banks. This means water one foot deep at a distance of two feet from shore.

When all smoothing is finished, disturbed ground should be limed, fertilized, and seeded. Double the lawn recommendations for your area. Sprinkle if necessary to assist the seeding. Consult your fish-and-game department for information on stocking your pond with fish.



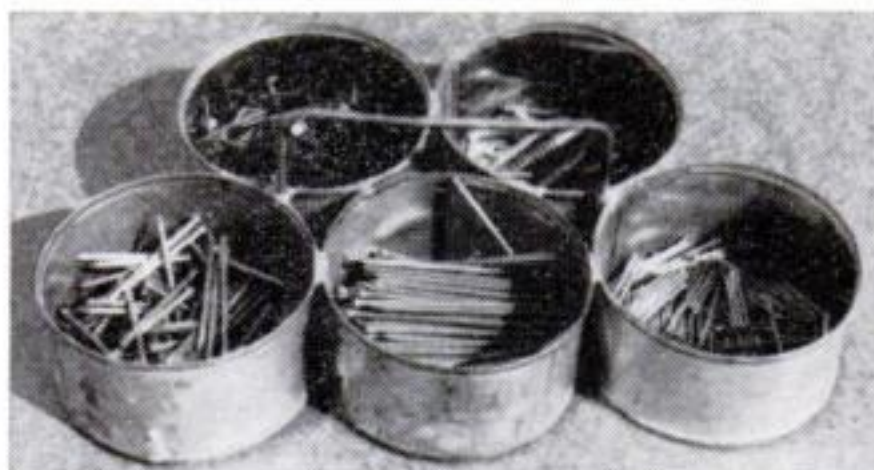
Handy applicator for solder paste

A tongue cut from sheet aluminum makes a far better applicator for solder paste than the nails, matches, and bits of wire or wood usually used. So the tongue wouldn't stray, I soldered one of my wife's barrettes to the top of the can as a holder. (She buys them two for a nickel, for her hair.)—D. S. Greenlaw, St. Petersburg, Fla.



Mending a rip in old canvas

Need emergency repair for a tent or tarp? Until you can add a permanent patch, sew alternately long and short stitches across the rip as shown. Be sure to anchor the cord in whole fabric, beyond each end of the rip.—George Daniels, Danbury, Conn.



Tin cans make no-cost nail caddy

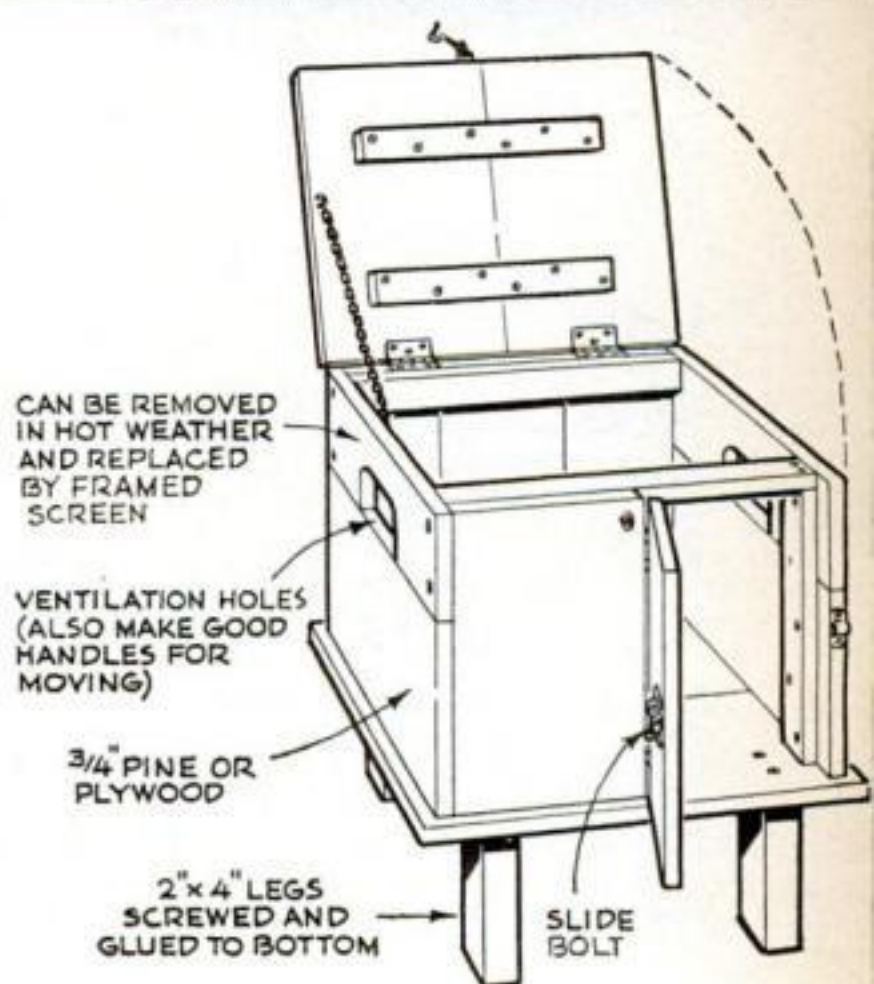
Solder a number of shallow cans together to form a sorting tray for small parts, nails, or screws. Use from three to seven cans, and solder a wire handle across the center, as shown, so you can carry the tray to the work.—R. S. Tupper, Canton, S.D.



Our Living-Room Doghouse

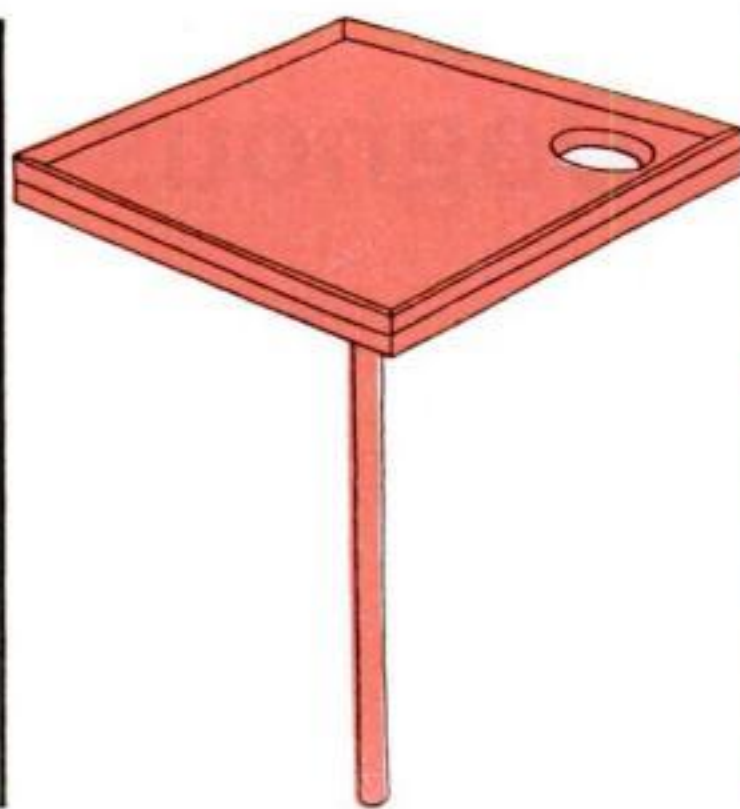
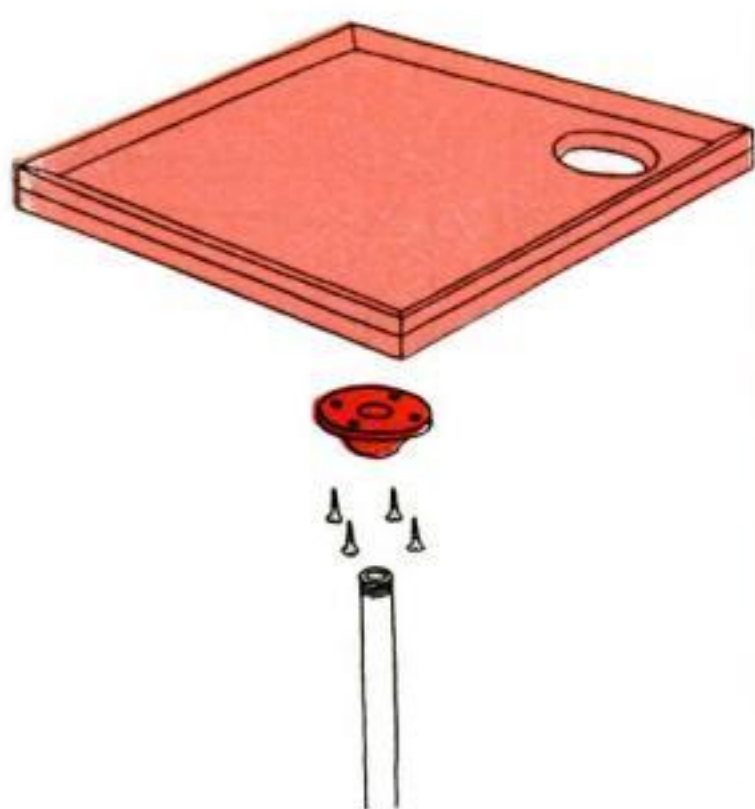
VISITORS get a chuckle when they see our dog hop out of this homemade cabinet. It's his indoor refuge whenever our youngsters wear him out. He also sleeps there at night and when we're away; it keeps him off the couches. The box also serves as a housebreaking trainer, since dogs have a distaste for fouling their own nests.

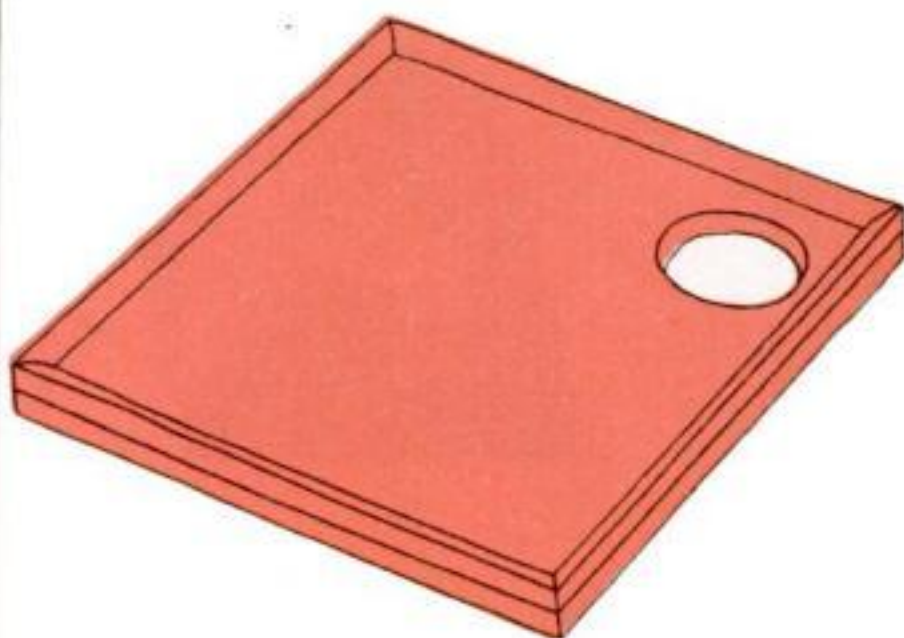
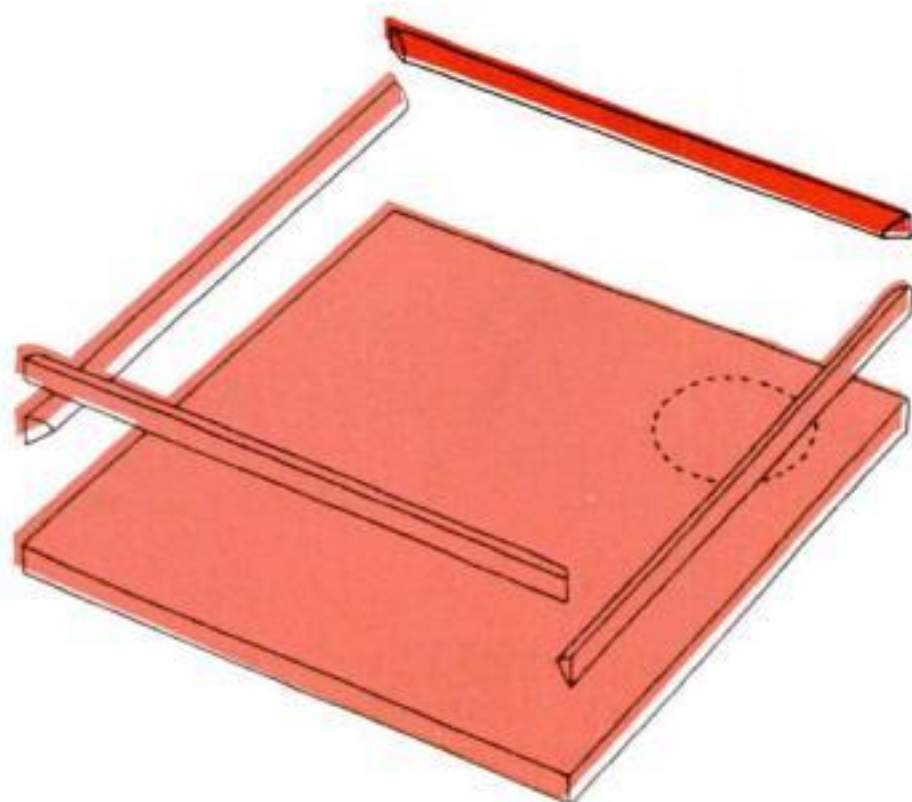
The cabinet is a pine box on stilts, stained to match our Early American furniture. The top lifts for easy cleaning. The inside is painted, and old scatter rugs pad the floor.—C. A. Huntington Jr.



Wordless Workshop

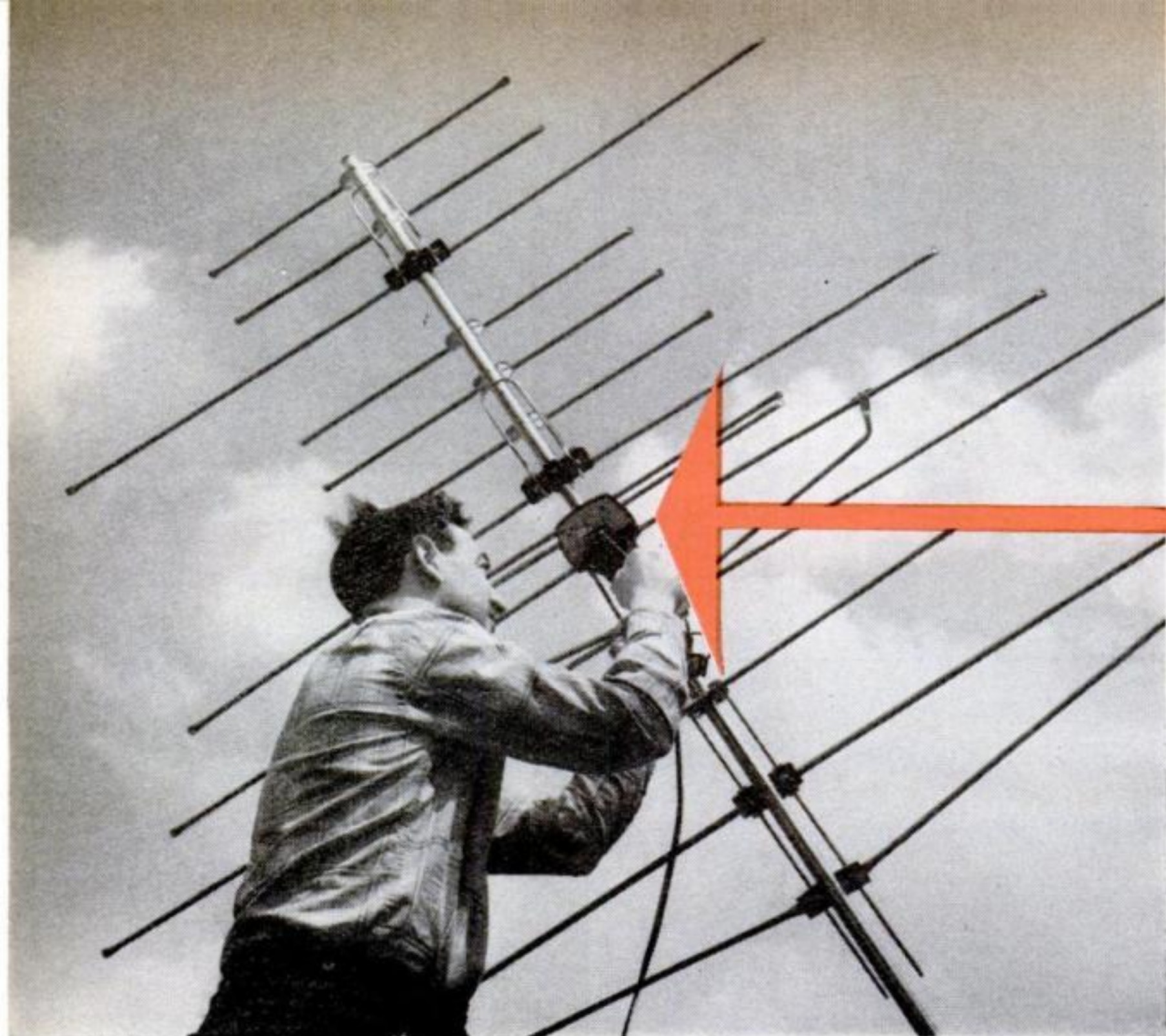
By Roy Doty





Got an idea for Wordless Workshop?

POPULAR SCIENCE will pay \$25 for each suggestion accepted for publication in this feature. Only rough sketches and a brief description are needed. Address: Shop Editor, POPULAR SCIENCE, 355 Lexington Ave., New York 17, N. Y. Contributions cannot be acknowledged or returned.



Transistors boost weak signals where it counts the most—at the antenna

By Charles Tepfer

CHANCES are you can get better TV pictures, no matter how old and tired your set, with one of the new electronic antennas. In fact, you may get a picture where there was none before. These antennas are turning TV dead spots into hot spots for viewers. One Arizona set owner I know was desperate enough to consider selling the old homestead after the two local stations moved their transmitters to the other side of the mountain, leaving him in a TV shadow. An electronic antenna brought TV back to his personal video wasteland.

How well do these new antennas really work? Exactly what will they do? To find

out, I set up two TV antennas side by side. One was electronic; the other was the same design but non-electronic. The setup let me switch from one to the other instantly while watching the picture. What I learned will be good news to anyone who has been putting up with a second-rate picture or limited choice of channels. The electronic antenna:

- Consistently produced a more contrasty picture.
- Cleared up snow on weak stations.
- Stopped vertical picture roll.
- Brought in a channel I had not been able to get before.

How does the antenna do it? By shoving more signal into the TV set. No antenna by itself can increase the signal it gets from the air, but the new electronic antenna doesn't work alone. It has a built-in transistor amplifier that boosts the signal *before* it takes the trip down the lead to the TV set. It's this trip that is the downfall of many a good TV signal. That's

New Electronic Antennas Pull In Better TV Pictures

when it gets clobbered by the TV demon—noise. But more about that later.

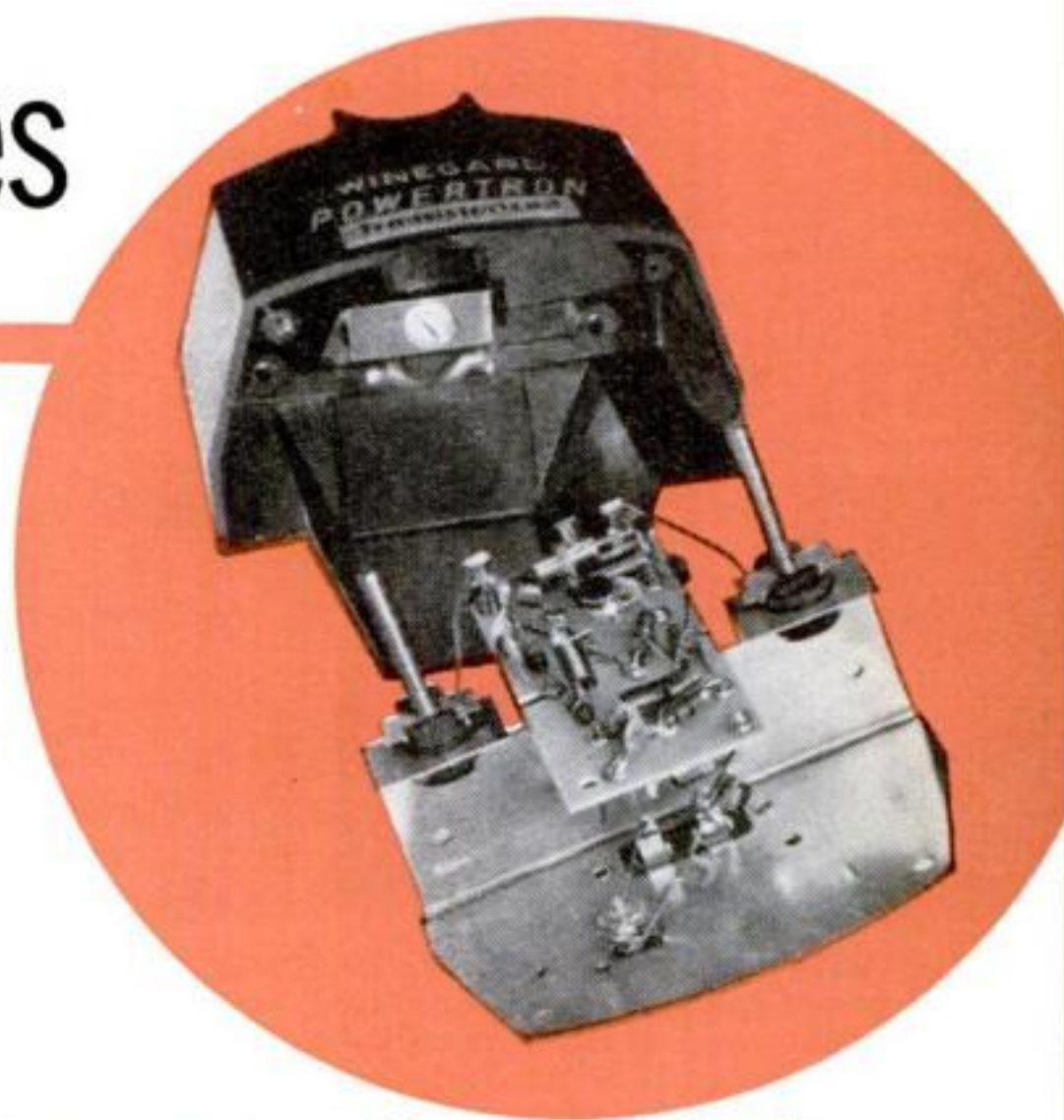
How they differ. Not all electronic antennas are the same. In some, the booster amplifier is a more or less integral part of the antenna. In others, you start with an antenna and tack on a specially designed booster. Most manufacturers make several models carrying different price tags. Which model is best for you depends on your location and reception problems.

To learn how the different ones behave, I checked four electronic antennas and three separate booster-antenna combinations. While all effectively pulled in the distant stations and cleared up snow, they were not equally effective in exorcizing ghosts and knocking out interference. For these, the basic antenna design is the important thing, and in particular, its directivity. This tells us how sharply an antenna will pick up signals from one direction and reject those from the sides and rear.

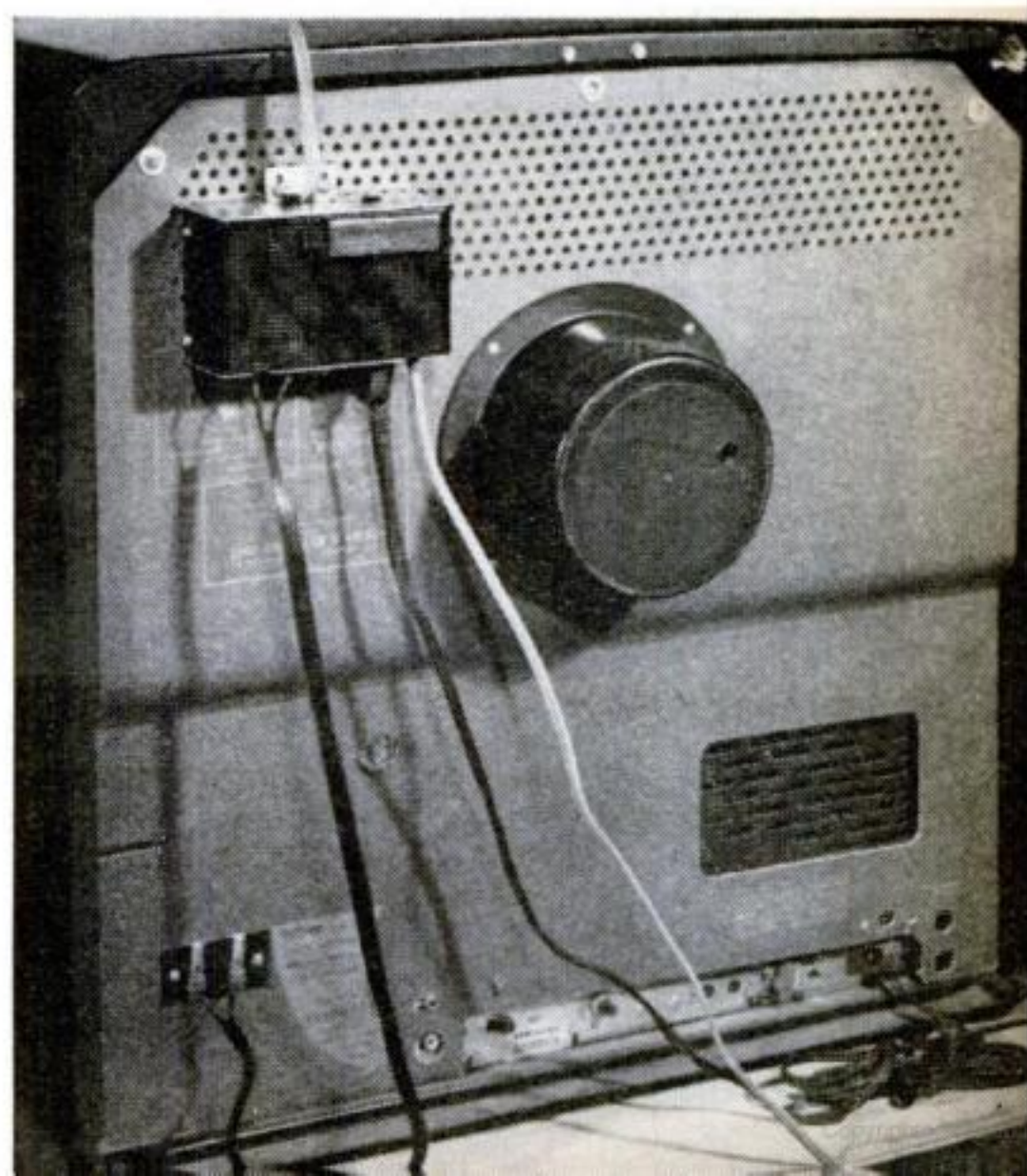
The more directive an antenna, the more effective it is against ghosts and interference, because they come at the antenna from all directions. As noted on the table on the following page, not all electronic antennas are equally directive. The most directive antennas look something like the skeleton of a fish and are called yagi's—after their inventor.

Some antennas also have higher gain than others—that is, they have more elements to absorb more signal from the air. These are especially suitable for deep fringe areas, 100 or more miles from the transmitter.

The booster, after transforming an even moderately weak antenna into a Samson of the air waves, does another important



New transistor amplifiers, mounted directly on the antenna, work best in fringe areas. They give maximum amplification of very weak signals with minimum noise. Power is fed to the transistors, from supply on back of TV, by same lead that brings the signal down to the set.





Both types, side by side: Electronic and non-electronic antennas were tried out. The transistor versions did a remarkable job of clearing up snow on the weakest channels and brought in a channel that had not been received before in the test location. There was no difference in ability to reject ghosts between the electronic and non-electronic types. Antennas listed below are ones actually tried—a sample of what's available on the market, not a complete list.

job. It cleans up noise, the biggest limiting factor in good picture reception. Noise signals are radiated by refrigerator and oil-burner motors, electric shavers, sewing machines, automobile ignition systems—in fact, by just about all electrical devices, including your TV set. You see noise on your picture tube as dark dashes, bars, herringbone patterns, swatches of dots, and even more exotic patterns. Even worse, noise may make the picture roll or tear.

Washing out noise. The transistor booster on the antenna helps solve the noise problem in two ways:

1. It amplifies only the signal picked up directly by the antenna, not noise picked up by the downlead that runs along the outside of the house, closer to appliances and cars on the street.

2. All electronic parts cook up a little noise while they are doing their jobs. The vacuum tubes in a TV tuner add quite a bit of noise to the signals they amplify; the new advanced-type transistors used in electronic antennas add less.

The location of the booster on the antenna helps you lick another problem: signal loss along the downlead. All transmission lines waste some of the power they carry. One hundred feet of ribbon-type twinlead cuts signal power by about one-third when dry, by nine-tenths when wet. The booster on the antenna amplifies signal power 30 times or more, to help it weather the trip down to the TV set.

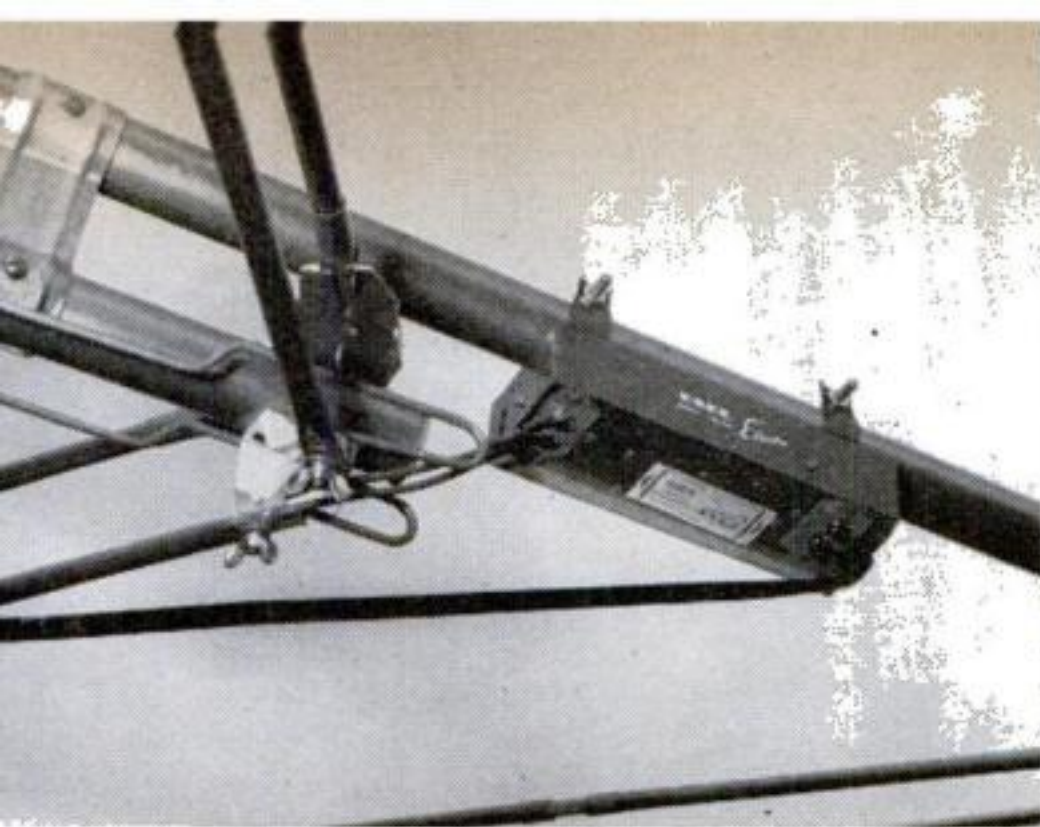
These Electronic Antennas Were Tested

MAKE	MODEL	TYPE OF ANTENNA	TYPE OF BOOSTER	LIST PRICE	POWER SUPPLY	OUTPUTS	RECOMMENDED FOR
BLONDER-TONGUE BOOSTER; ALLIED-KNIGHT ANTENNA	"Signal Master" AB-4 "Five Star" 87-CU-811	16-element all-channel yagi	Transistor*	\$76.40	Battery	4	Fringe to deep fringe reception; high front-to-back ratio
CHANNEL MASTER	"Jetron 0020" booster; "Traveling Wave" antenna	10-element all-channel yagi V-beam	Transistor	\$104.90	AC	4	Fringe to deep fringe areas; high front-to-back ratio
FINCO	"Geomatic Nova-tron" N-GB-8	9-element all-channel yagi	Transistor	\$73.20	Battery	4	Suburbs to fringe areas
JERROLD BOOSTER; JFD ANTENNA	"De-Snow" DSA-202 "Satellite Helix" AX1111	25-element all-channel yagi-helix	Vacuum tube†	\$144.95	AC	1	Fringe to deep fringe areas; high front-to-back ratio
JFD	"Transis-Tenna" ATT520-AC	18-element all-channel yagi	Transistor	\$71.95	AC #	4	Fringe to deep fringe areas
TACO	"T-Bird Electra" G990-8	8-element all-channel yagi V-beam	Transistor	\$107.20	AC	2	Suburbs to fringe areas; high front-to-back ratio
WINEGARD	"Powertron" P-55	14-element all-channel yagi	Transistor*	\$74.95	AC	1	Suburbs to fringe areas

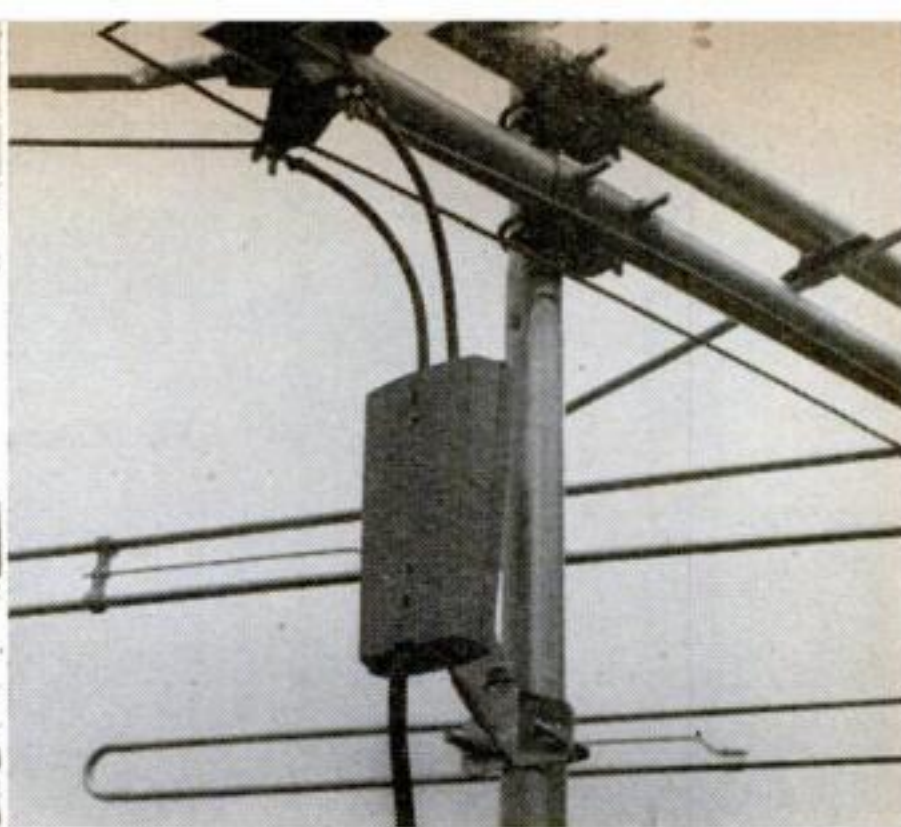
*Vacuum-tube models also available

†Transistor models also available

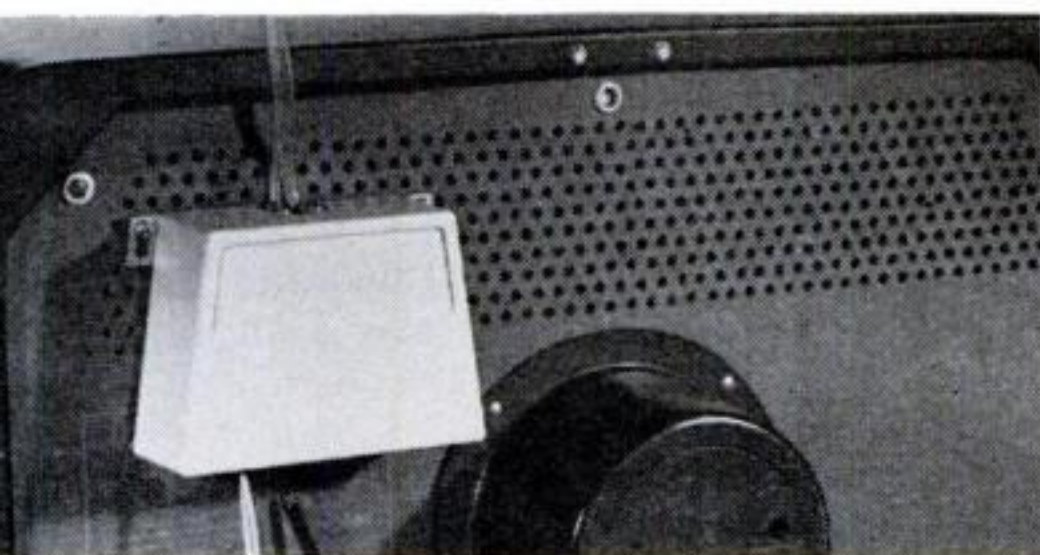
Also available with battery power supply



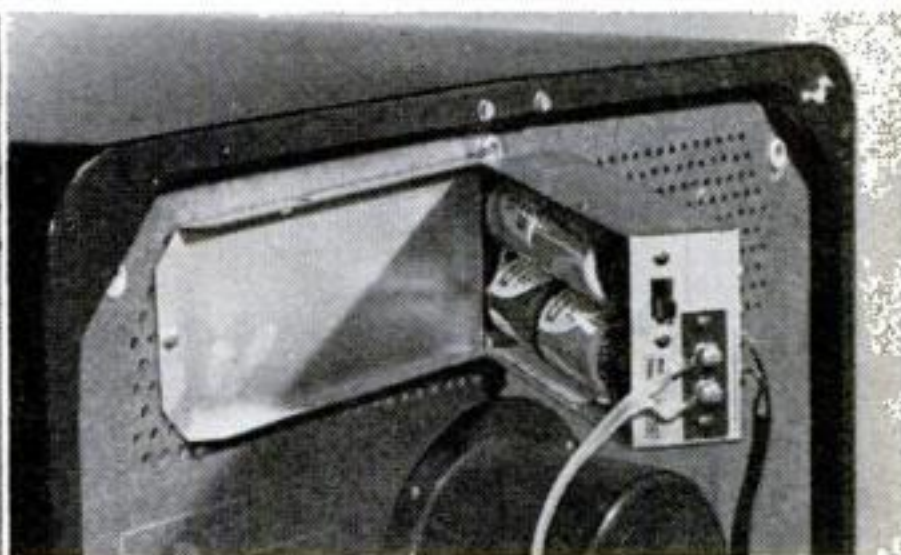
Location of the booster on the antenna creates a big advantage: amplifying signal before it can get mixed up with noise from local sources picked up on trip down the lead to the set.



Separate mast-top boosters are also available for converting your present antenna. Development of transistors able to handle TV frequencies has made the top-side boosters practical.



AC-type supply plugs into standard electric outlet, delivers 20 volts DC to booster. Coupler that enables you to connect two TV sets to the same antenna is built into the box.



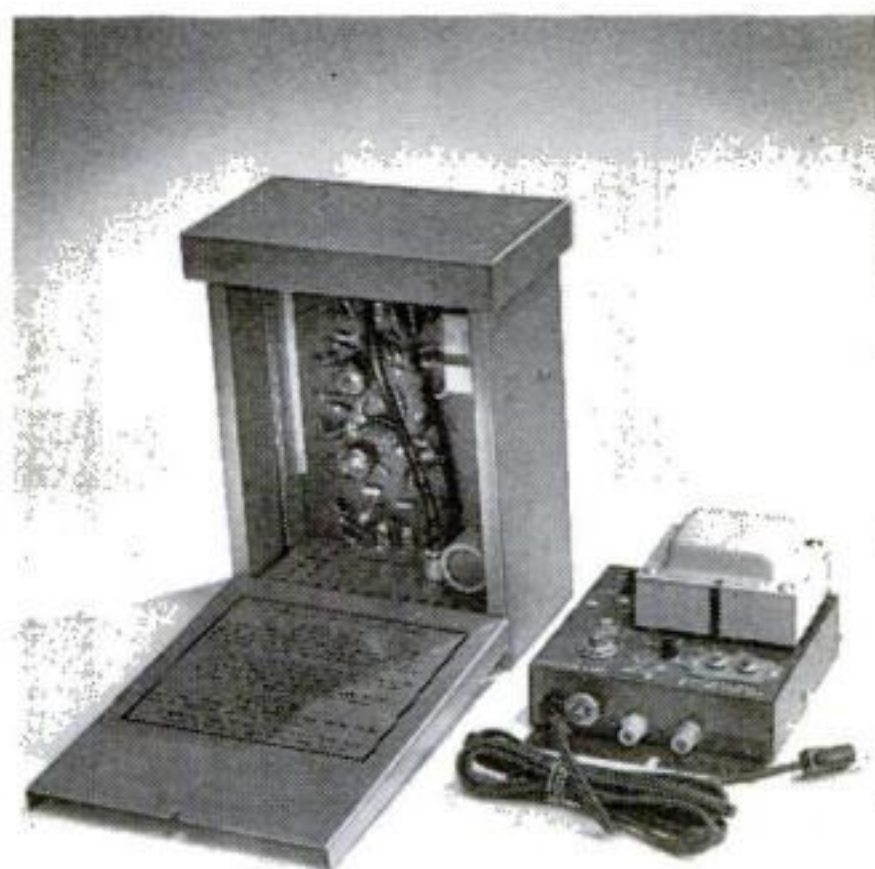
Battery power used by some boosters comes from four standard flashlight batteries. The batteries usually need to be changed after every four or five months of operation.

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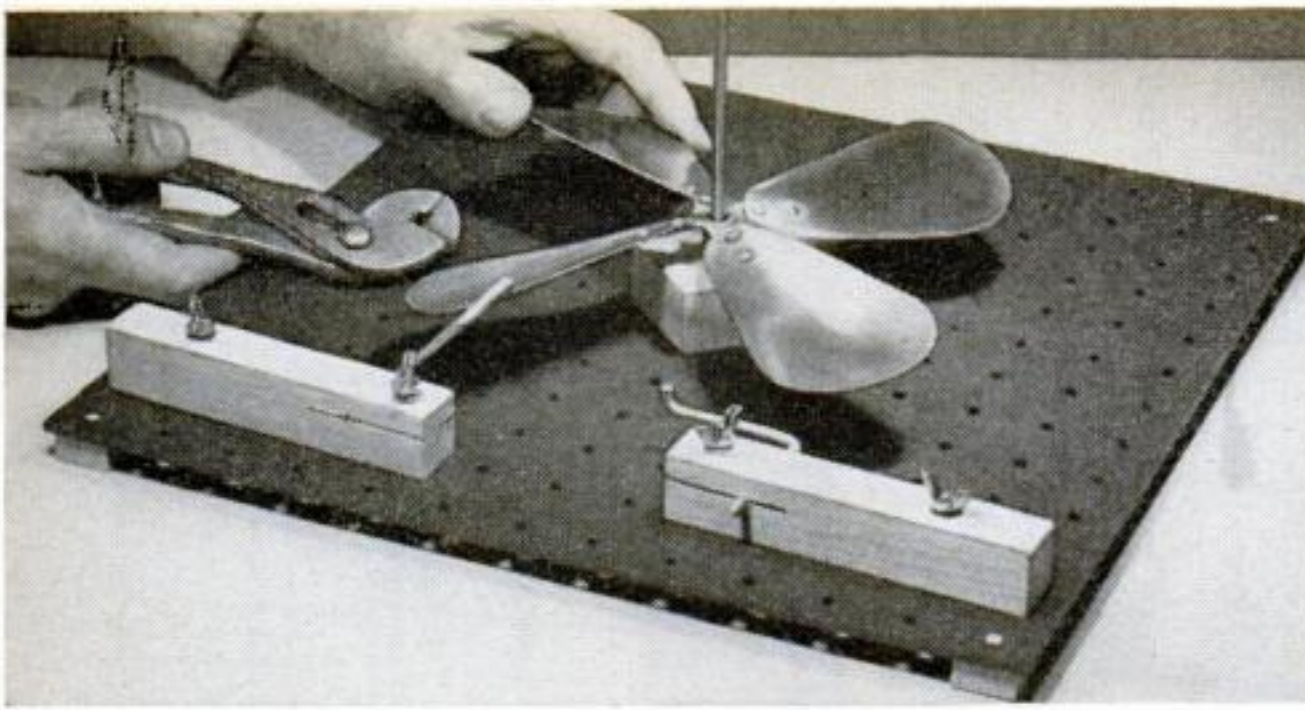
What Does It Mean?

When buying an electronic antenna these are the terms you will hear or read:

1. **Db. (decibel)**—a relative power unit, based on logarithms. For example, an antenna with twice the power of another is 3 db. stronger.
2. **Signal-to-noise ratio**—comparison of TV signal power to the noise fed into a TV receiver. The higher this figure, the better.
3. **Noise figure**—a measure of the noise that an antenna-booster-downlead system adds to TV reception. Expressed in db., it compares an antenna installation with a theoretically noiseless system. The lower this figure the better. Most electronic antennas have a noise figure of about 5 db.
4. **Front-to-back ratio**—the amount of signal the antenna accepts from the front compared with the amount it picks up from the back, for the same station. The higher the figure, the more effective the antenna against interference and ghosts.



Tube-type boosters are bulkier, less rugged, don't amplify as well as transistor units, but do a better job of handling strong local channels. Power supply is at the right.



Aligning jig is a panel of perforated hardboard to which are fastened a 2"-by-2" maple pivot block with hole through center, and two kerfed wooden blocks to hold adjustable "feelers" bent from aluminum clothesline wire. It stands on corner feet.

How to Balance an Electric Fan

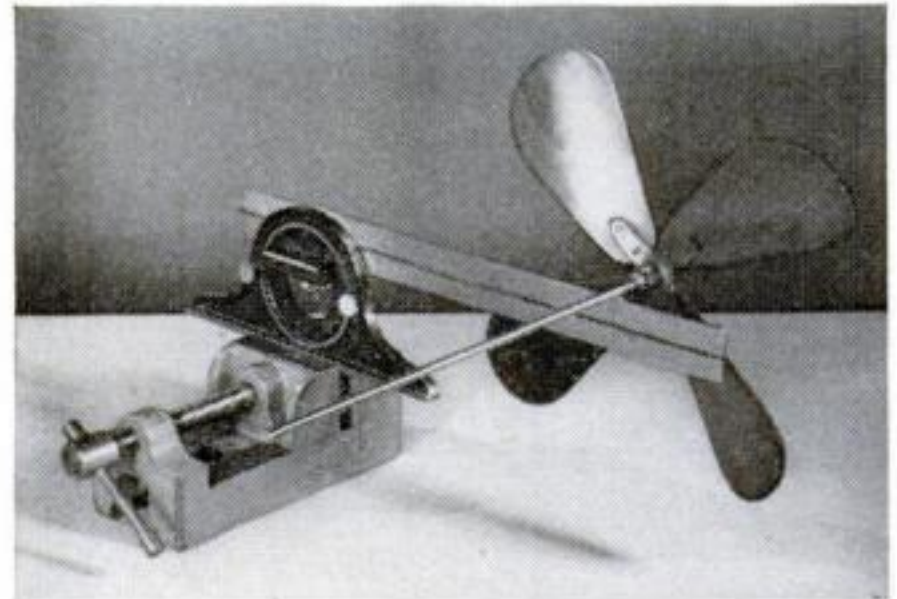
NO SOUND is more typical of summer than the racket of an electric fan. Whether you plug in a shiny new one or dig out a relic from winter storage, it's likely to rattle like a captive helicopter.

Noise usually means the blades are unbalanced or twisted out of alignment. For top performance, all blades should have the same weight, the same degree of twist, and should revolve in the same plane. You can true them up with two simple tests.

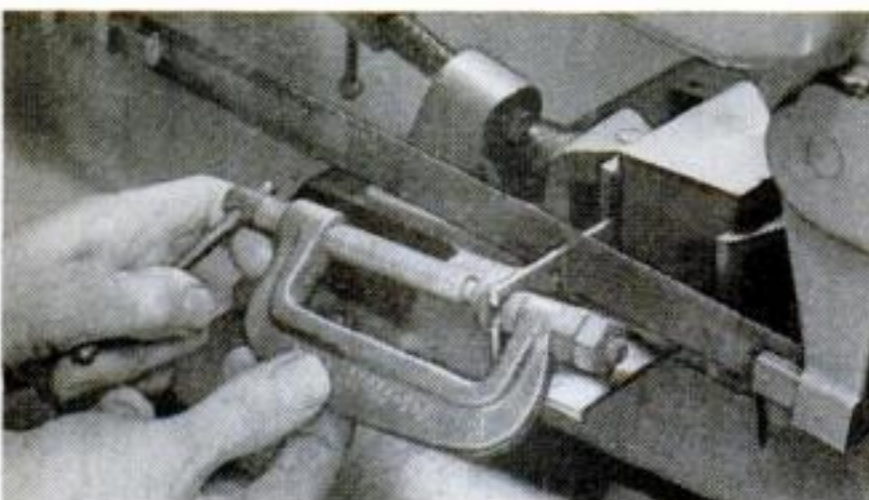
The first requires a jig you can build from scrap. It's adjustable for different-sized fans. Mount the fan on a foot-long drill rod, letting the rod project about $\frac{3}{8}$ " on the setscrew side of the hub. Insert this projection in the pivot-block hole (it should be a snug fit) and adjust the wire feelers—one to graze the top edge of the blades, the other the bottom edges. As you turn the fan, bend and twist the blades that don't conform. Lift the fan from the block for bending, so you don't flare the pivot hole or bend the rod.

For the static-balance test, rub the ruler edge on a fine oilstone to smooth away

irregularities. One way to lighten a blade is to cut or grind the edges; another is to drill or grind shallow depressions in the back surface. Make frequent tests so you don't remove too much metal. Don't try to balance by *adding* spots of solder to the lighter blades; such weights may fly loose, later.—Walter E. Burton.



Static balance can be tested by balancing rod-mounted fan across blade of square, clamped level. Rod will roll until heaviest blade is down. Metal is removed until blades are of equal weight and won't turn rod along blade.



Extra weight silences vibration noise

When a small piece of metal, such as the angle iron shown at left, sets up a vibration squeal in my power hacksaw, I tighten a C clamp on the free end. This trick is equally effective with a hand hacksaw. The clamp increases the mass of the piece being cut off, reducing vibration. Besides being noisy, excessive vibration can affect cutting action.—Walter E. Burton, Akron, Ohio.

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the values of remodeling

The satisfaction of plenty of space for entertaining, for storage, for just plain living . . . a separate, private area where the children play out from under foot, where they sleep undisturbed . . . the summer joys of indoor-outdoor patio living . . . a kitchen with twice the room you've ever had, and everything handily built-in . . . these are obvious values of remodeling.



Remodeling makes cents. Home improvements achieve more than making life enjoyable. They are a sound and lasting investment. When done properly, they never wear out as most other things your money buys. A well-planned project, with expert construction and quality materials, will increase the value of your home beyond the cost of the remodeling.

Your home grows with your family. More children, growing children — more family possessions . . . these space problems arise as the years slip by. Storage space seems to shrink the longer you live in a home. Remodeling makes your life easier. You can provide a place for everything, space for everyone. Your home can be adopted to fit both current and future needs.

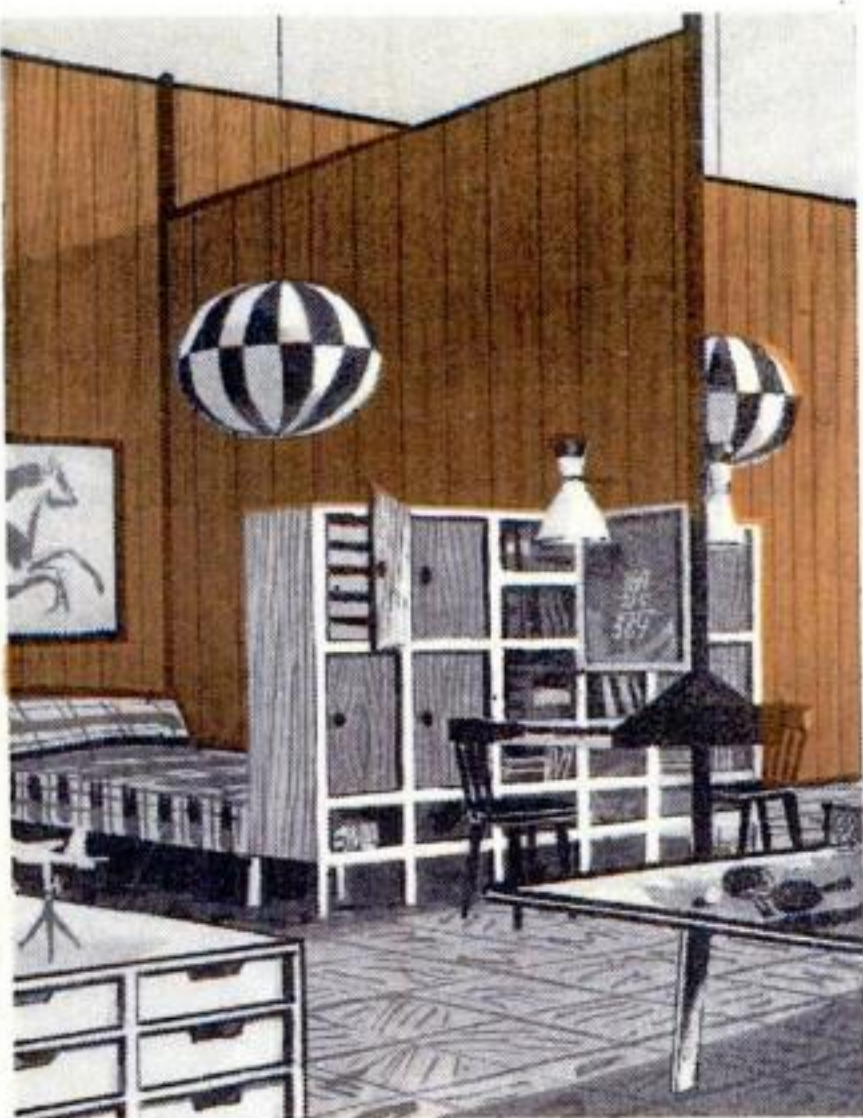


You escape the upsets of moving. Moving often causes more problems than it solves. Remodeling your present home will enable you to remain in the home and neighborhood you've grown accustomed to . . . the children keep their school ties . . . you retain your circle of friends and your shopping conveniences. Improvements are made without the expense and inconvenience of moving.

You achieve a better way of life. The values of remodeling add up to a better way of living for your family. The dollars invested are returned with a bonus in home value. You gain growing room. You have new pride in your home and new, relaxing comfort. You retain the advantages of your present home, eliminate the disadvantages. Now's the time to satisfy your living demands with a Home Improvement program.



remodeling ideas



Create new children's space . . . include provision for storage, provide privacy for growing personalities.



Convert your garage to living area . . . get indoor-outdoor enjoyment, give the children private play space.

Add luxury to your living with panelings and flooring that give a newly rich interior for dining or entertainment.



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With details on home improvement ideas, now available at your 'Improve-A-Home' Dealer.

steps in successful remodeling



Determine your needs . . . Decide just what you want to accomplish with your remodeling project . . . more storage space . . . modernizing . . . more light and air, etc. Whatever your improvement goals, get them firmly in mind before you proceed. Often, if you know the specific benefits you seek from remodeling, your contractor or building materials dealer can suggest ideal solutions you may not have considered.

Gather your facts . . . Compile all the essential measurements of the area you are remodeling, including door and window dimensions. Collect idea brochures, magazine articles and advertisements that show the type of improvements you desire. Make notes on the built-ins you want . . . on lighting effects desired . . . on placement of furniture in the remodeled area. Rough sketches on the changes you seek will be very helpful.



Select your remodeler . . . Your building supply dealer who displays the G-P "Improve-A-Home" sign can recommend a remodeling contractor for your project. Take your ideas and information to the dealer . . . he can show you examples of improvements similar to your plans . . . he can advise you on materials, on financing, and on design service. Or, you may have friends who've remodeled and can recommend a reliable contractor who will work with your G-P dealer on design, materials and financing.

Estimate your costs . . . With sufficient details on your remodeling plans, your dealer can help you select materials from his stock. Advise him how much you intend to invest. He will tell you how close your plans are to this amount. With your cost estimate, you're ready to select a financing plan.



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Your Georgia-Pacific "Improve-A-Home" dealer will handle full arrangements on this convenient plan. You get instant action . . . no plans and specifications are required in order to get your loan, and no property inspection is needed.

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The G-P Finance Plan requires no downpayment before work is begun on your home.

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The G-P Finance Plan features easy terms. You may borrow on a term from 1 year minimum to 5 years maximum to repay your loan. Prepayments may be made without penalty.

FINANCING UP TO \$5000

The G-P Finance Plan is available for projects costing a minimum of \$200 up to a maximum of \$5,000. Arrangements can be made in special cases for improvements totaling more than \$5,000. The agreement is in note form up to \$3,500, or a mortgage for larger amounts.

FREE CREDIT LIFE INSURANCE

Life insurance for your family's protection is included in the G-P plan at no extra charge for persons under 65.

materials to make your

Remodel in less time . . . enjoy the job for a lifetime with factory-finished Georgia-Pacific materials. These durable, beautiful products cut "torn up" time on your project. They reduce installation costs . . . and G-P materials give you pride in the finished job for the lifetime of your home, increase the value of your improvements. Materials below are only a few examples of the full range of G-P remodeling materials. Ask your dealer to show you these outstanding products.



G-P imported hardwood paneling offers distinctive grain patterns and striking colors. These luxurious woods (Rosewood, above) are imported from all over the world . . . add unusual flair to living, dining or recreational areas.



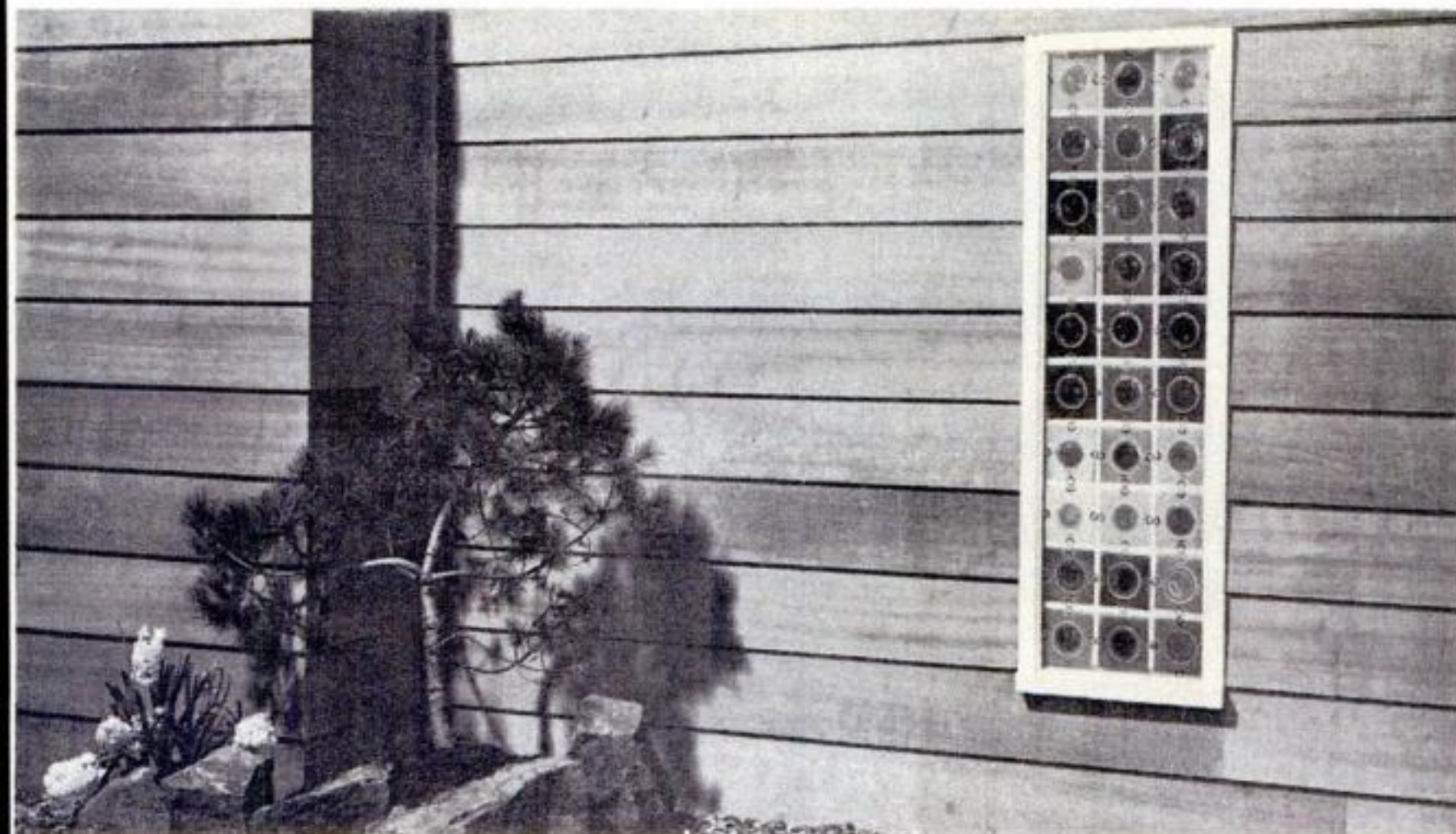
G-P hardboard paneling is factory-finished with perforation above, attractive wainscot below. It provides practical wall space for children, is economical, and can be used as storage wall anywhere, painted any color. Ask for Garage Liner.

remodeling a success!!!



G-P factory-finished hardwood paneling comes in a wide variety of woods (Honeytone Oak, above). You have a complete choice of pattern, color and price. Famous "Family-Proof" finish gives easily-cleaned, damage-resistant surface, enhances appearance.

G-P redwood bevel siding is both attractive and practical. Natural beauty is complemented by this rugged material's resistance to rot and insect damage. It also offers high insulation qualities for protection from both heat and cold.





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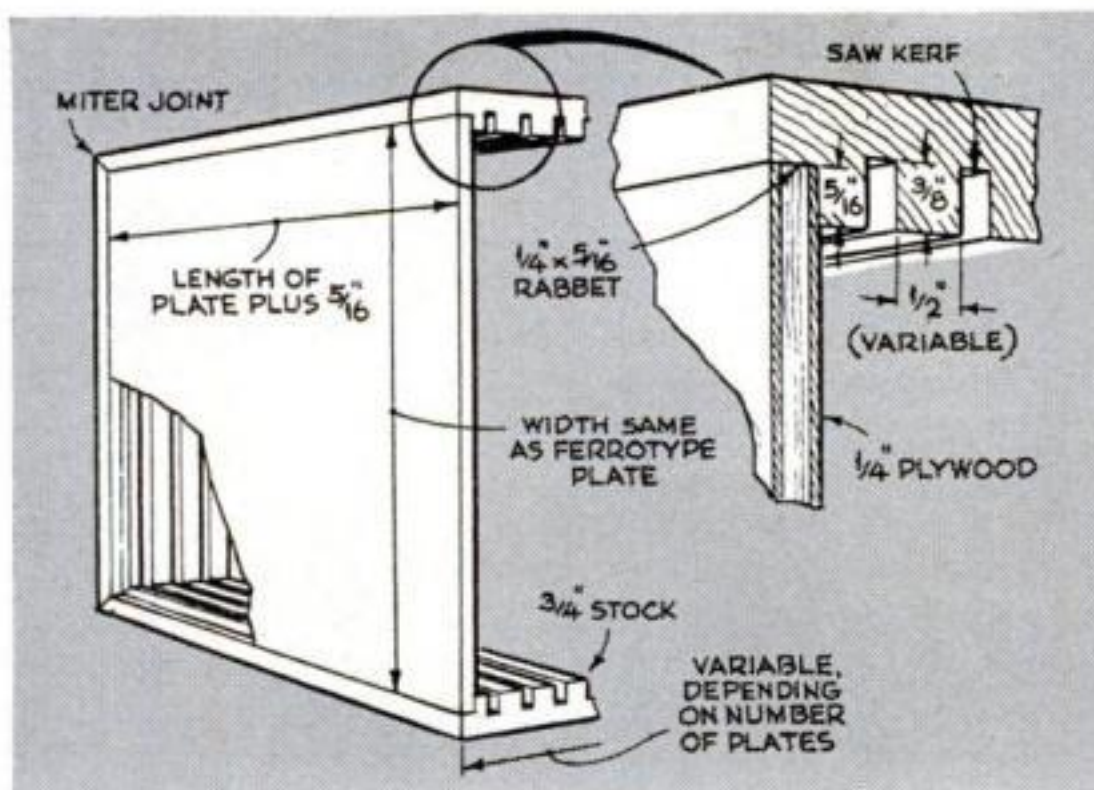
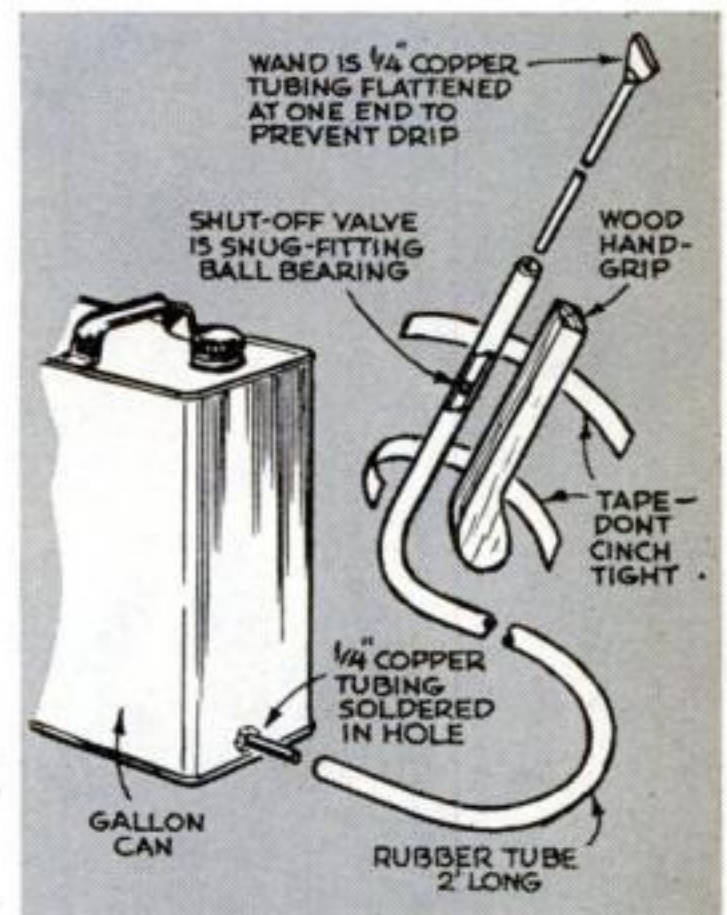
EQUITABLE BLDG., PORTLAND 4, OREGON



A spot weeder you make from scraps

Chemical sprayers are fine for broadcasting applications over wide areas, but you can't attack individual weeds with them. If you spray 2,4-D to rid your lawn of dandelions, plantain, chicory, or ragweed, you'll also kill most of the clovers. All a weed needs to kill it is one squirt

at the center. This spot weeder, designed at the Vermont Agricultural Experiment Station, delivers just the right amount when you press on the ball valve. The tube flattens enough to let less than a teaspoonful pass into the wand. For this type of direct application, dilute one part 2,4-D with 40 parts water. To fill the gallon can, use $\frac{1}{4}$ cup of the liquid concentrate.



Storage box for ferrotypes plates

Stand this darkroom box on end, and it takes only a few inches of shelf space. Or lay it on one face; it's sturdy enough to

support anything you want to stack on top. Either way, its compartments keep a selection of ferrotypes plates within easy reach, yet protected from scratches and settling dust.—Jack Kenison, Tacoma, Wash.



Big doings in 8-mm. sound equipment now make it easier than ever to have —

Home Movies That Talk



You record right on the film in a whole new breed of compact 8-mm. sound projectors. Recording, erase, and playback heads are built

into the machine, work like miniature tape recorder. This Kodak model has inputs for both mike and phono, sells for about \$345.

By Philip C. Geraci
and Sheldon M. Gallager

HOME movies are about to take a giant step toward a whole new form of family entertainment: They're about to talk. New developments in 8-mm. sound equipment make it possible to set up a miniature Hollywood studio right in your living room. When you show those waves crashing on the beach, you'll actually *hear* them crash. Vacation scenes will take on new excitement as your voice supplies a lively prerecorded commentary—while you sit back yourself and enjoy the show.

In the past, sound equipment has been a

costly and elaborate luxury, available only for 16-mm. and 35-mm. professional films. Now there are compact 8-mm. projectors, some selling for less than \$200, that let you record speech, music, or special sound effects right on your present films.

You can also buy an attachment that converts an ordinary silent projector to direct sound recording. Still other accessories enable you to use a standard tape recorder to supply the sound track for a silent film. In many cases, you'll find that a home hi-fi system already provides much of the needed sound equipment in the form of speakers, amplifier, and phonograph, putting you a big jump ahead in the sound game.

Manufacturers expect 8-mm. sound to do for home movies what compact cars have

done for the auto industry: start the business buzzing. There's a reason. Sound is not just a luxury; it makes good practical sense. It can help to overcome one of the biggest problems home moviemakers face—that of providing truly dramatic action. With sound, a thunderstorm really thunders, wind really howls, a speedboat races past with a realistic roar, and the trip up Pikes Peak becomes an exciting adventure as you describe it in a running account.

Putting a sound track on film. You can now add a magnetic recording track to 8-mm. movies as easily as you get your regular films developed by trotting to the drugstore. In fact, that's just what you do.

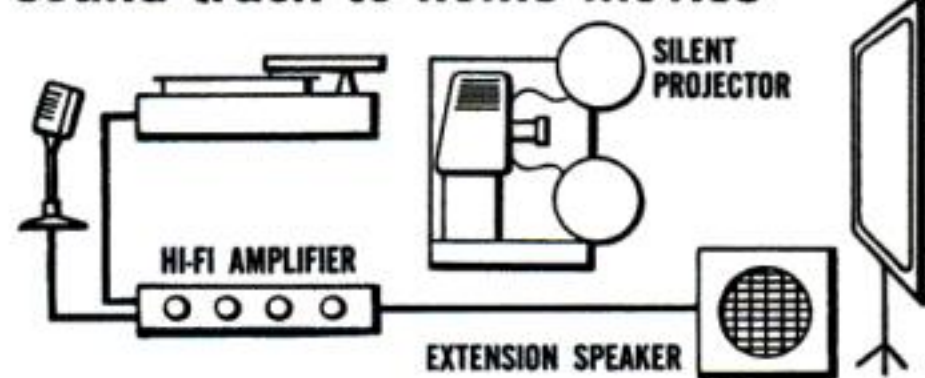
The process, developed by Eastman Kodak, consists of putting a narrow stripe of iron-oxide coating along the edge of the film after it has been exposed and developed. When the film is run through a sound projector later, the words or music you want to add are magnetically recorded on the iron-oxide stripe in the same way as on tape in a tape recorder. The recorded sound is then played back through an amplifier and speaker as you project the film on a screen. The cost for having your films striped is six cents a foot, or \$3 for a 50' reel.

Also coming soon is a small, portable film-striping outfit for home use that will allow you to put a magnetic sound track on your own movies in a few minutes. The iron oxide is automatically deposited along the edge as the film moves past on motor-driven spools. The device will be sold by Mansfield under the name of Argus-Syntronic Soundstriper. Price will be \$70 to \$80. In addition to home use, the striper will also be available at photo dealers for on-the-spot striping of films.

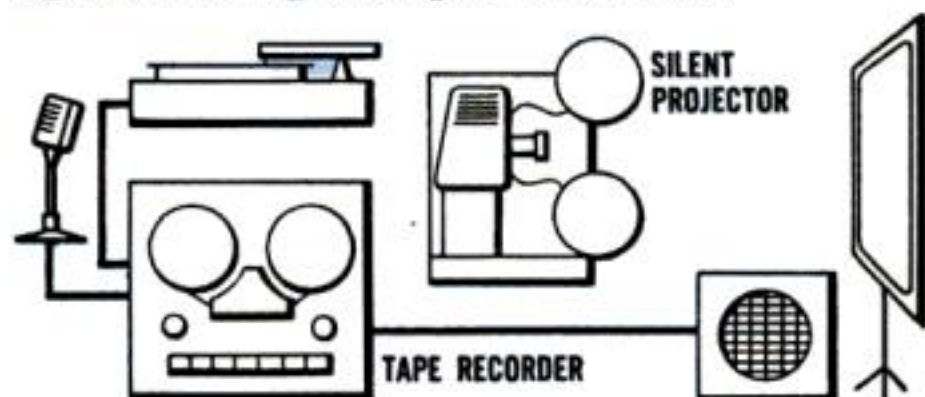
Both the Kodak and Argus striping can be applied to any 8-mm. film, old or new, at any time. It's not necessary to have it done when the movies are first shot. This means that hundreds of feet of ancient film, long consigned to the attic, can be dug out and given new life with the magic of sound.

You can add sound in many ways. You don't have to start at the top of the price ladder to enjoy the benefits of sound—that's one of the fascinating things about it. Many moviemakers add musical backgrounds to their films by simply playing phonograph records, with an extension speaker placed near the screen for greater realism. Special records, containing various

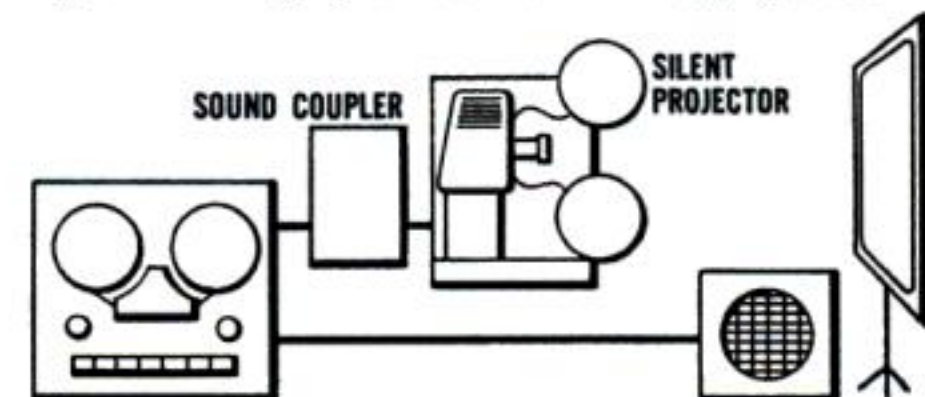
Five ways you can add a sound track to home movies



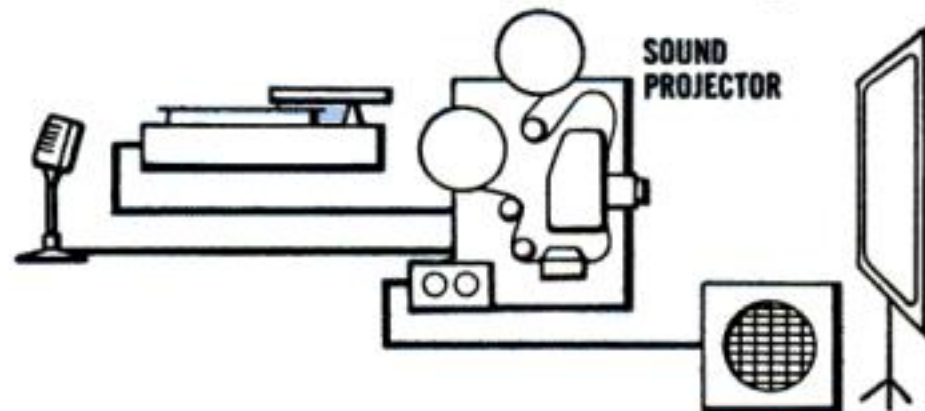
1. On-the-spot sound track can be made for a silent projector by playing records on a hi-fi rig and reading a script into its mike.



2. For a permanent sound track, script and music are first recorded on a tape recorder. Tape is then played back as film is projected.

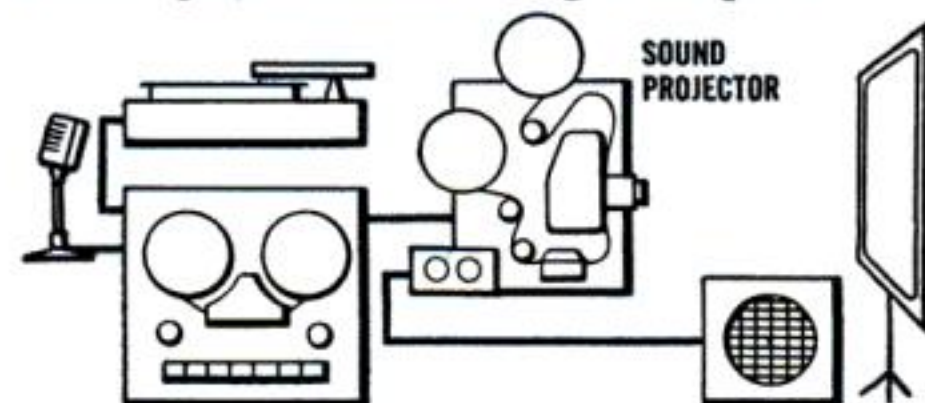


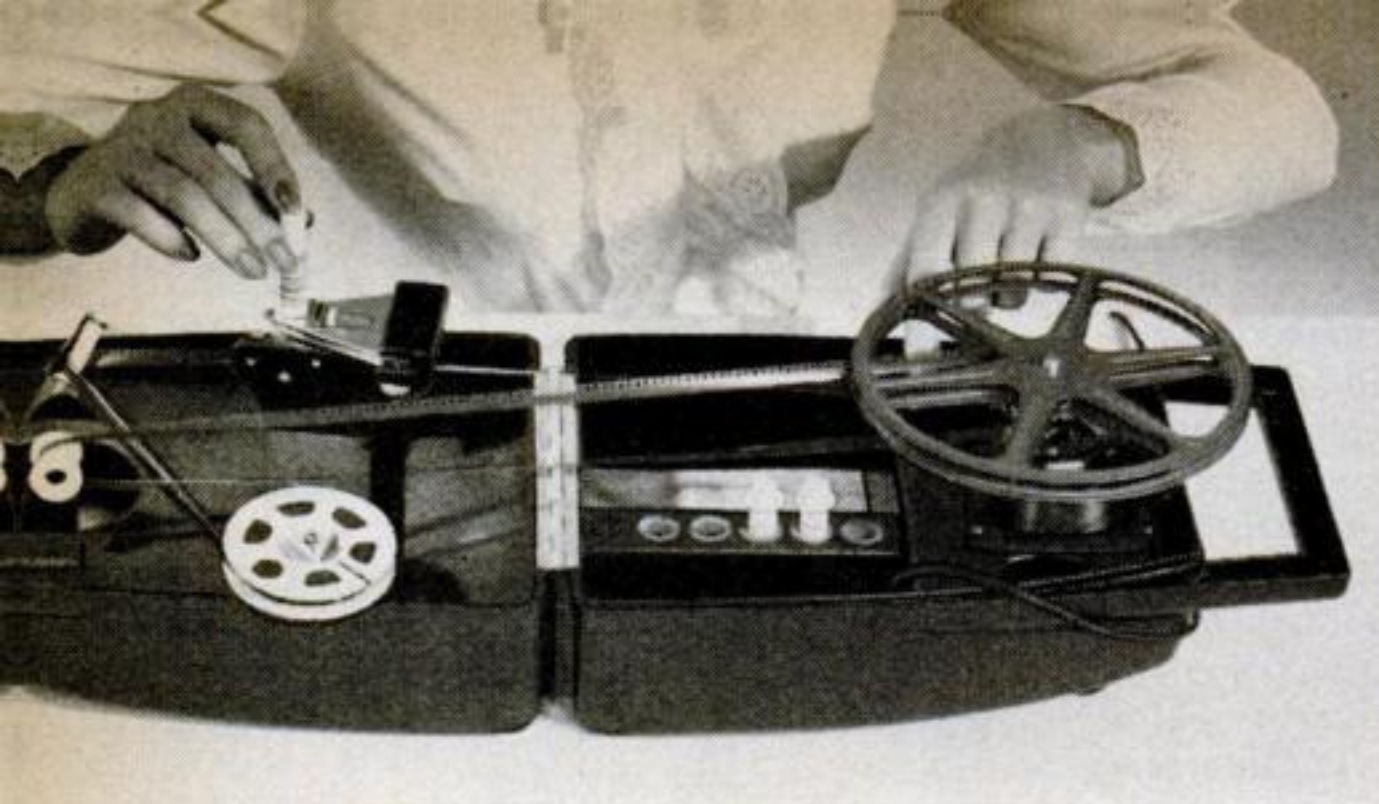
3. For synchronized sound, projector and tape recorder are coupled together with a device that locks the film in step with the tape.



4. With a sound projector, script and music are recorded directly on the film and played back automatically as the film is projected.

5. Separate sound track is recorded first on a tape recorder, then re-recorded on film in a sound projector after editing is completed.





New home striping outfit automatically puts a magnetic recording ribbon on any 8-mm. film as it moves along on motor-driven reels. After striping, the film can be recorded in any



8-mm. sound projector, such as the Mansfield at right. The striper will sell for \$70 to \$80, the projector for \$180, both from Mansfield Industries, 5950 Touhy Ave., Chicago.



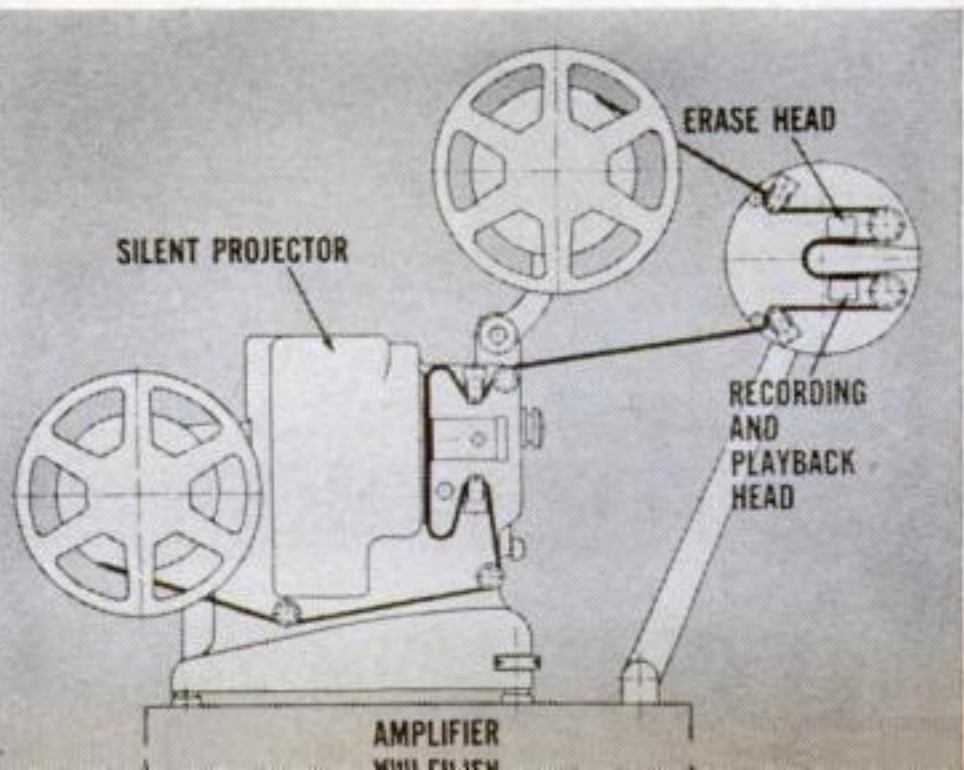
The sound track goes on tape in this German Bauer system. To keep the projector in step, the tape turns a commutator placed alongside. This sends electrical pulses to a synchronous motor in the projector, driving it at the same

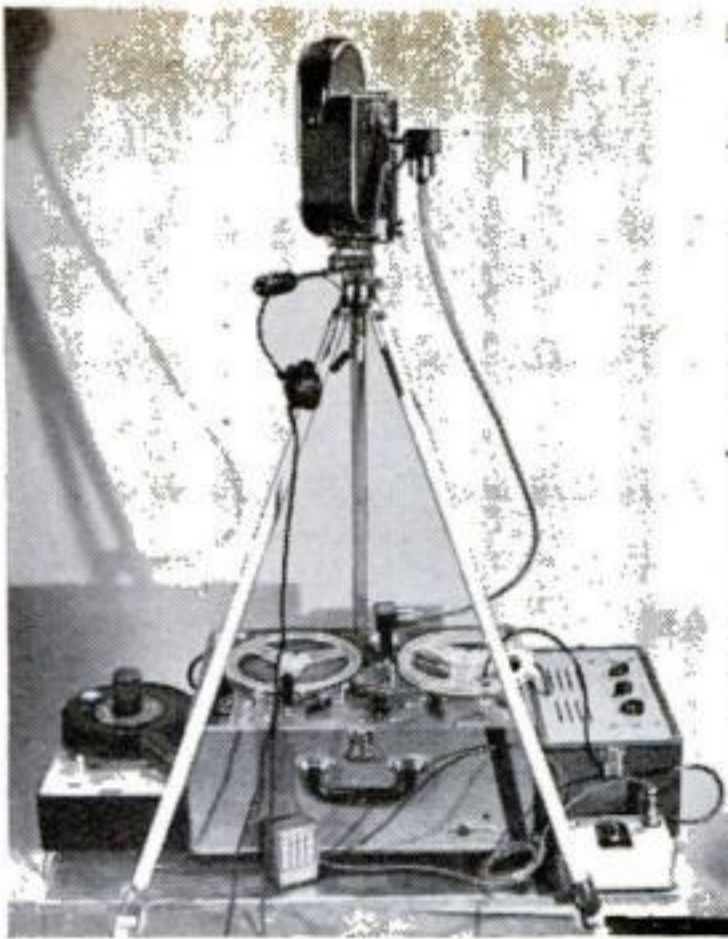


speed. Price: About \$100 for the synchronizing coupler, \$140 for the projector, from Intercontinental Marketing Corp., 45-17 Pearson St., Long Island City, N. Y. A similar camera coupler is also available.

You can add sound to a silent projector with this accessory. You place the projector on top of an amplifier and thread its film through a recording head mounted on an arm. The head

records directly on any 8-mm. film that's been prestriped and plays back as the film is projected. The Bolex Sonorizer sells for \$250 from Paillard Inc., 100 Sixth Ave., NYC.





A complete studio-on-a-tripod, this rig records live sounds on tape as the camera grinds away. Film and tape are synchronized by a flexible shaft between the recorder's capstan and the



camera. For playback, a similar shaft links the recorder to a silent projector, as at right. Installations cost \$150, are made by Movievox, 806 Lexington Ave., San Antonio, Tex.

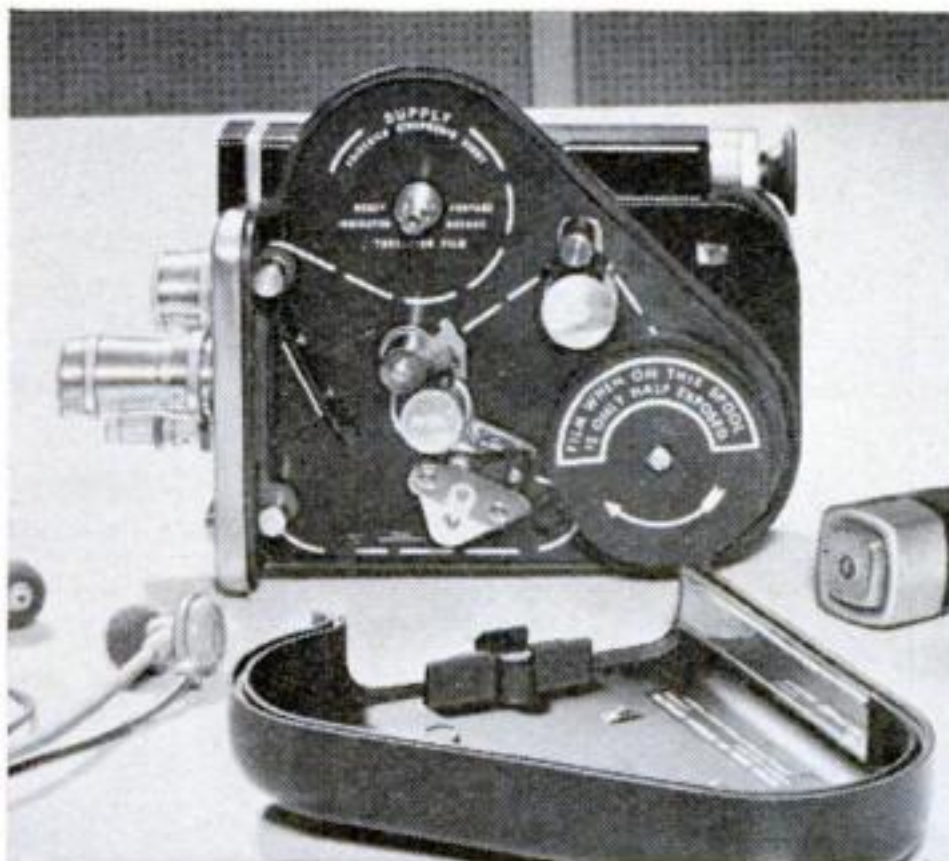
types of music and sound effects, are made for just this purpose and are sold at music stores. One, just brought out by Kodak, offers such sounds as laughter, barking dogs, and unusual music. It's available directly from Eastman Kodak, Rochester, N. Y., for \$2.95.

Add a tape recorder to your setup and you have an easy way of making a permanent sound track that can be played right along with a silent projector. You record the sound track while watching the movie

so you can time your comments to fall at the right places. To put on a show, you simply start both the projector and tape recorder going at the same time.

There's one problem: The projector and recorder will not follow each other exactly because of slight variations in speed caused by changes in line voltage and other factors. The method is perfectly adequate, however, for general scene description, background music—anything that does not

[\[Continued on page 185\]](#)



Direct sound-on-film moviemaking is possible with this battery-powered camera, the first in 8-mm. size. As the film is exposed, it passes through a magnetic recording head, left photo,



at the bottom of the camera. The sound is then played back through a sound projector. Price is \$269 from Fairchild Camera and Instrument Corp., 580 Midland, Yonkers, N.Y.

Picking the Right Film for the Job

By Jackson Hand

TODAY'S "all-purpose" roll films are designed to give the average photographer almost positive assurance of good pictures. Almost—but not quite.

Under normal conditions, you'll get excellent results with a film like Kodak's Verichrome Pan or Ansco's All Weather Pan. These are intended to produce an acceptable photograph over a wide range of picture-taking situations. You don't, however, get the same quality over the whole

range. As soon as conditions veer away from the average, quality falls off.

One of the most important things to determine first is just what "average" is and how far you can go on either side of it before an all-purpose film becomes a no-purpose film.

What seems ideal may not be. You set out on a perfect day for a picture-taking session down at the beach or high on a sunny hill. What, you figure, could be more ideal?

When you get the prints back, however, they don't look too clear. Faces are blank and there's a lack of detail. You can't tell where the boat sail leaves off and the sky begins.

What happened? For your all-purpose film, you simply had *too much* light. In many simple cameras with limited settings, all-purpose films are actually at their best under "cloudy-bright" conditions. On bright days, these cameras let in too much light, and the result is dense, black negatives with details washed out. It is interesting to note that professional photographers always prefer a negative that is quite thin and easy to see through.

What's the answer? One of the top photofinishers in the country told me: "I wish all my customers would switch over to Panatomic-X film for all their outdoor photography, especially in the summer. It has about half the light sensitivity of all-purpose films, but will give you all you need for ordinary outdoor work. Besides, Panatomic-X, because of its extremely fine grain, will produce a much clearer and sharper enlargement whenever you want big prints."

"Latitude"—a confusing word. When an all-purpose film is said to have great latitude, what is really meant is that the manufacturer's recommended exposure is a safe

Which Films Work Best When

	CONDITIONS	FILMS	TYPICAL FINDINGS
FINE-GRAIN SLOW FILMS	Bright sun on snow, sand, water	Panatomic-X Isopan IF Pan F	Extremely high quality; big enlargements possible without grain; can be used for most outdoor work
	Bright sun in average yard		
	Flash bulbs		
ALL-PURPOSE MEDIUM-SPEED FILMS	Bright sun, subject in shade	Verichrome Pan Plus-X All Weather Pan FP3 Isopan ISS	Very good results over a wide range of conditions; electronic flash brief enough for safe use without burning these films; regular flash can be used if bounced
	Cloudy but bright		
	Moderately early or late in day		
	Electronic flash		
	Photofloods, small areas		
HIGH-SPEED FILMS	Available light indoors	Tri-X Super Hypan HP3 Royal-X Record HPS	Results remarkable in poor light, but sometimes grainy in enlargements; too fast for outdoor use except very late or early in day
	Very early or late in day		
	Photofloods, large areas		

[Continued on page 204]

New Plastic Varnishes

For a really tough finish that will shine like new for years, try the new epoxies or polyurethanes

NEXT time you need a varnish, think about the new ones made of polyurethane or epoxy resins. They're tough. They've already proved themselves in industry. Makers present some surprising claims for them. For example, the varnishes are said to:

- Stand up two or three times as long outdoors as a spar varnish.
- Adhere tightly to wood, metal, concrete, plastic, and fiber-glass.
- Resist marring, scratching, and staining.
- Retain their high gloss for years.
- Be unaffected by most alkalies, acids, and common chemicals.

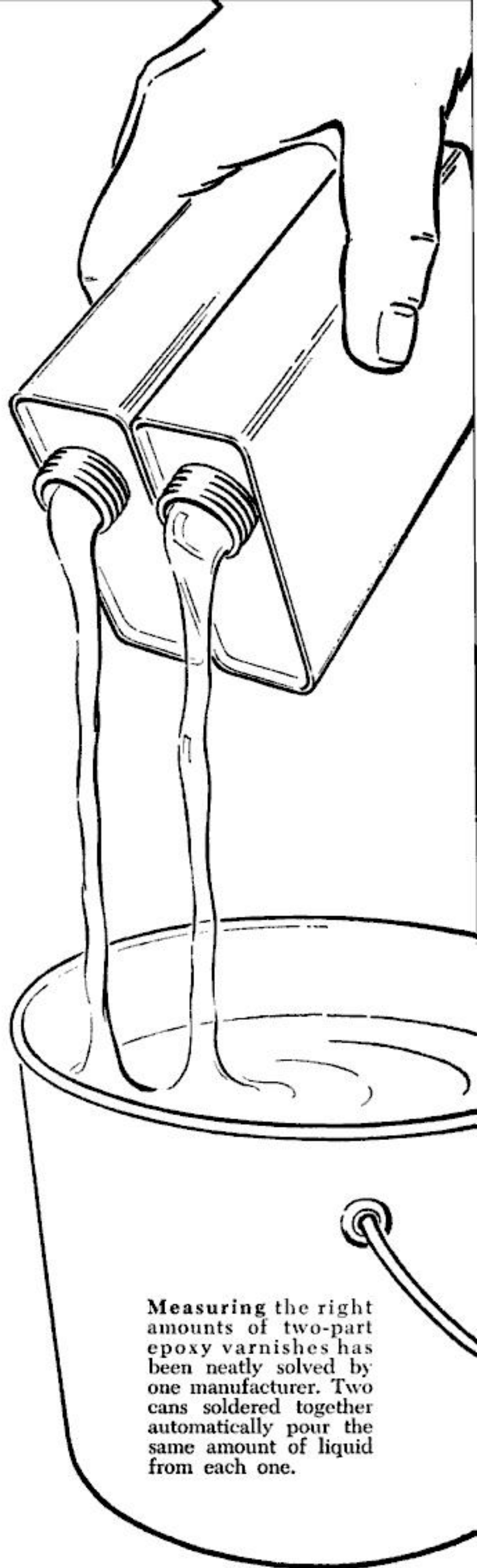
Are such claims true? In many cases, yes. But there are limitations and characteristics you should know about before you rush out to buy.

Originally both epoxies and urethanes were made in two-component systems only. Each consisted of a resin and a catalyst packaged separately and mixed just before use. The pure epoxy coatings (and the commercial or industrial polyurethane coatings) are still packaged this way. The two-component system gives the toughest and most chemically resistant film of all.

One-package systems have recently been developed, however. These do not have the same adhesion, hardness, and chemical resistance as two-package types but are cheaper and easier to use.

One-package epoxy finishes are made of an epoxy derivative, formed by mixing certain oils and other resins with the pure epoxy resin. The result is a stable, one-package product that can be handled and applied like any other varnish without prior mixing.

One-package urethane coatings also are an oil-



Measuring the right amounts of two-part epoxy varnishes has been neatly solved by one manufacturer. Two cans soldered together automatically pour the same amount of liquid from each one.

modified product. They are packaged as stable, one-part liquids and can also be handled like conventional varnish.

Are the new varnishes worth it? The plastic coatings usually cost a good deal more than a conventional varnish. But this doesn't mean that they will always be worth more for every job. A regular clear varnish may still be your best bet for those applications where you don't need the extra toughness or chemical resistance that an epoxy or urethane varnish will provide. On those jobs you'd be paying for qualities you don't really need. Expert furniture finishers (and practically all old-timers) still claim that for a fine rubbed finish you're better off with a good quality oil or resin-type varnish—the kind that's been on your dealer's shelves for years.

Two-part epoxies. For easy use, in addition to the ready-mixed, one-part varnishes, you can also buy simplified versions of the pure, two-part epoxies. These come in pre-measured containers. All you do is mix the two halves together in one can. Or you can measure off proportionate amounts of each if you don't want to use all the material at once. One manufacturer (D. J. Peterson) has set up an ingenious packaging system. The two parts are in identical flat cans soldered together on their flat sides. As you pour out of one, an equal amount automatically runs out of the other. This neatly solves the problem of measuring equal quantities, and also permits you to mix only as much as you need.

Two-part epoxies cost much more than one-part epoxy varnishes. They are worth the extra cost for those jobs where you need the extra durability they offer.

But they do have drawbacks. Careful and thorough mixing of the resin and the catalyst is very important. You should shake or stir each container first, mix them together, and stir thoroughly for at least five minutes. If you're doing a small job and need only part of the contents, you must carefully measure out the right proportions before you mix.

Once the two parts have been mixed, the pot life of the material is limited. It may keep only a few hours, or three or four days, depending on the manufacturer's formulation. After this the ingredients will harden into a solid mass—even in a tightly closed can. You can extend the pot life by storing the mixed material in a refrigerator. But be sure to allow the material to return

to normal room temperature before you use it again.

Choice of finish. Both epoxies and urethanes are made in high-gloss and semi-gloss finishes. As with any varnish or enamel, you should apply two or three thin coats, allowing each to dry completely before adding the next.

The new finishes are quick-drying—two to four hours. So you can apply two or three coats in a day. However, the last coat needs from 7 to 15 days for full curing. This means that if you apply the finish to a floor or a boat deck, you can walk on it the next day, but you should avoid hard wear for at least a week. The label will usually give you specific data on this point.

Many of the plastic varnishes have powerful solvents that may react with other finishes; be careful about applying them over a previous finish. Most will not bond satisfactorily over lacquer. Test first by brushing on a small sample. Let this dry. Usually, a 15- or 20-minute waiting period will be enough to tell you whether the new finish is going to be okay.

Clean the old surface thoroughly of all dirt, grease, or wax. Any of these will interfere with a good bond and may keep the new finish from drying properly. It's easy to clean the old surface by scrubbing with steel wool saturated with benzine, naphtha, or a similar solvent.

The finishes can cure properly and attain maximum hardness only if the solvents in them evaporate completely. So the area must be adequately ventilated after the job is done. Even the two-part epoxy coatings (which cure by chemical action rather than by solvent evaporation) need ventilation. They usually contain solvents added during the manufacturing process to make them easier to handle. The solvent vapors, being heavier than air, tend to remain suspended over the surface if the air is still. This can cause a sticky film to form and the finish may remain soft and be susceptible to peeling and rapid wear. To prevent this, open the windows or use fans to circulate the air over the surface.

How much do they cost? Two-part epoxy coatings are the most expensive, a quart costing from \$5 to \$6, a gallon from \$18 to \$22. The ready-mixed, one-part epoxy finishes cost less—from \$7.50 to \$9 a gallon on the average. Most of the better-quality urethane varnishes sell for \$10 to \$12 a gallon.

Quick Facts About Plastic Varnishes

TYPE	TYPICAL BRANDS	APPLICATIONS	FEATURES	LIMITATIONS
ONE-PART MODIFIED POLYURETHANE	Hue-All Spar Valane Dura-Thane Bri-Mar Uravar Commodore Spar Varathane	Marine varnish; sealer and finish for wood floors; exterior siding and trim; furniture and paneling	Has excellent resistance to weather; will stand up two or three times as long as spar varnish; has excellent gloss retention and will not crack under temperature changes; gives very hard finish, exceptionally resistant to abrasion, scuff marks, and stains; finish is not damaged by water, detergents, or alcohol; no mixing required	Tends to darken with age when used indoors; thorough sanding required between coats or finish won't stick over itself; cannot be used over shellac; many brands won't stick over lacquers
ONE-PART EPOXY	Valspeed Pierseal McTuff Epoxy Enterprise Crystal Clear Woolsey Satin Varnish	Finish for both wood and concrete floors; paneling and trim; furniture	Outstanding adhesion and will stick over almost any type of clean surface; exceptional resistance to acids, alkalis, and other chemicals; will effectively seal concrete floors and walls and stop dusting and seepage; won't yellow or darken with age; no mixing required	Special thinners required for some brands; most brands intended for indoor use only, tend to chalk and crack when used under severe outdoor conditions; some have solvents that react with other finishes—test should be made before recoating old work
TWO-PART EPOXY RESIN	Tile-Cote Poly-Aqua Acidex Z-Poxy Regatta	Finishing boats and marine surfaces; waterproofing swimming pools and basements; coating ceramic tile; finishing counter tops and kitchen cabinets	Tremendous adhesion and can be used to recoat almost any type of surface; greater chemical resistance than any other finish; impervious to attack by practically all common chemicals; forms strong, flexible film that won't crack readily and will withstand very rugged wear; good water-proofer	Requires mixing before use; has limited pot life; powerful solvents may react with old finish; some people allergic to solvent; may lose gloss when used outdoors because of tendency to chalk slightly
VINYL	Quick-15 Magic Sealer Swiftie	Wood floors; interior paneling and wood trim	Dries very quickly; little or no objectionable odor; exceptionally clear and pale in color; requires no special thinners — ordinary turpentine or mineral spirits will do; no mixing required	Won't stand up outdoors; film is relatively thin, so several coats needed to build up high finish; easily attacked by some chemicals and solvents
TWO-PART AMINO RESIN	Target	Wood floors; interior paneling and wood trim	Tough finish when applied full strength; not damaged by common solvents or chemicals; clear film will not darken with aging; can be supplied over old varnish or shellac	Must be mixed before use; can't be used outdoors; must be thinned for use on furniture or paneling; can't be applied over old lacquers

The square feet you'll get out of each can varies with the method of application—and with the porosity of the surface over which you are applying it. In most cases you'll get 400 to 500 square feet per gallon for the first coat over raw wood; from 500 to 600 square feet per gallon for the second coat. On fairly smooth concrete floors, the first coat may cover about 300 to 400 square feet per gallon; the second, about 400 to 500 square feet.

How epoxies and urethanes compare. Experts say that urethanes stand up better than epoxies outdoors. Applied in two or

three coats on a boat hull or house exterior, the film looks glossy and in good shape after two or three years. (This compares with an average life of little more than one year for spar varnish under the same circumstances.) The epoxy tends to lose its gloss and starts to chalk slightly within less than one year. On epoxies designed for exterior or marine use, this chalking is a controlled action that usually won't harm the film although it will no longer have its original gloss.

Epoxy varnishes have far greater adhesion than the urethanes, or any other

type of coating, for that matter. Because of this, epoxy coatings are widely used for such tough jobs as coating concrete floors and walls, and permanently sealing porous masonry surfaces of all kinds. The epoxies are also more resistant to chemical attack than the urethanes.

Floor finishes. Urethane varnish dries with a hard finish, unusually resistant to abrasion and staining. For this reason it is widely sold as a finish for floors that get very hard wear—gymnasium floors for instance. Even roller skating will not harm the surface.

These floor varnishes also have excellent resistance to water and detergents, and will give yeoman service when used on outdoor patios or porches. In one recent test, a mahogany panel coated with urethane floor varnish was immersed in water for 26 months. At the end of that time it showed no blistering, softening, whitening, lifting, or loss of film gloss.

Because the urethanes dry with such a hard finish—and because they do not have the adhesive power of the epoxies—you have to be careful when applying a urethane over itself. The old, glossy surface must be thoroughly sanded down to provide a good “tooth” for the new coating. Any cheating on this preparatory work may cause the new coating to peel off in a short time. After sanding the old finish, don’t forget to clean the surface thoroughly to remove all loose dust before you start applying the new material.

Epoxy varnishes are also frequently sold as floor sealers. They are not quite as clear as the urethane varnishes in many cases, but they are less likely to darken with age when used indoors—a characteristic common to most of the urethane finishes. In addition to their exceptional bonding strength, the epoxy varnishes are also, by far, more resistant to chemicals. Because of this chemical resistance, epoxy coatings are often used for finishing concrete floors. A two-component pure epoxy coating is also available to waterproof leaking joints in basement walls or swimming pools.

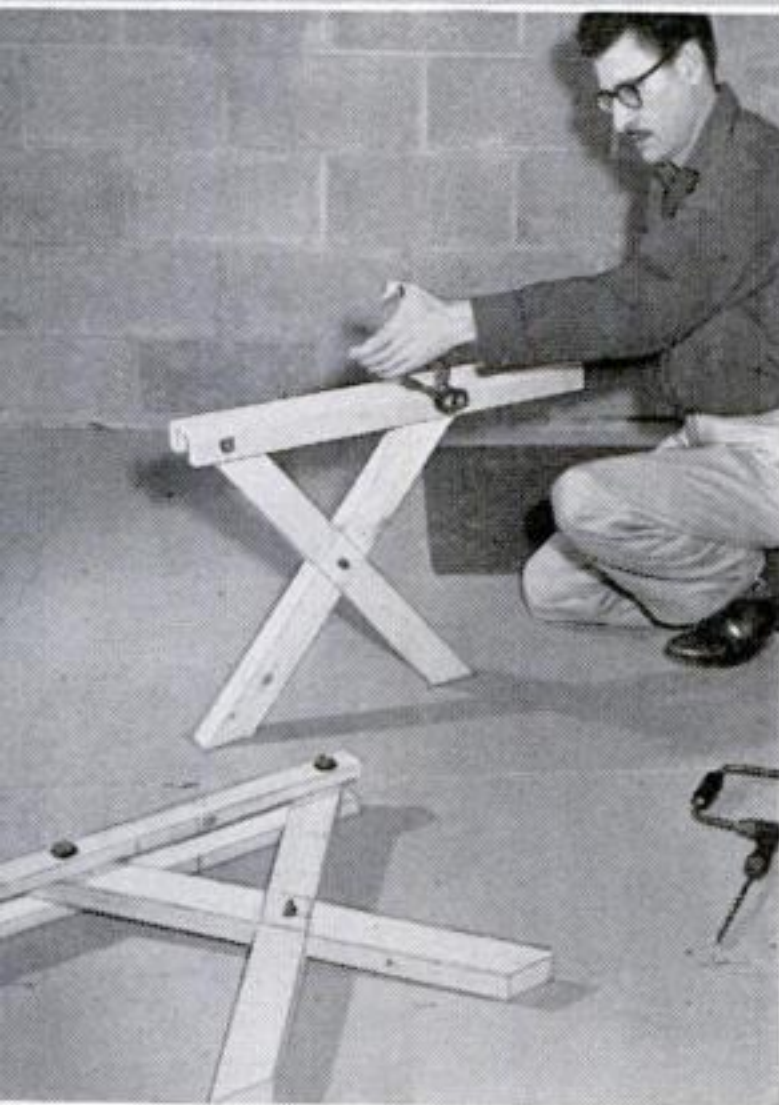
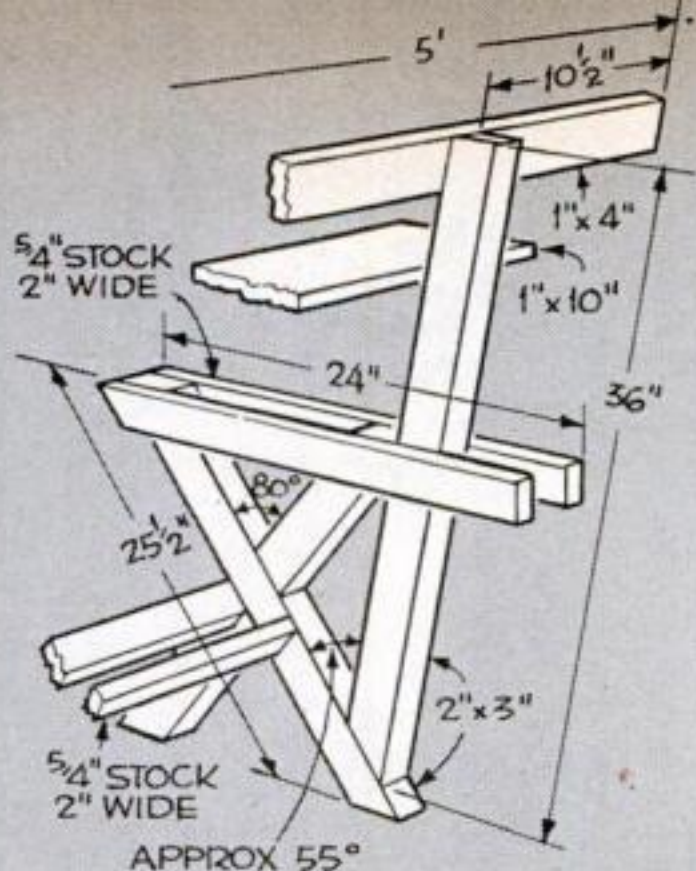
Other plastic varnishes. In addition to the epoxy and urethane varnishes, there are two other types of clear plastic coatings sold for wood floors and paneling. One is a vinyl-type finish; the other is a new kind of two-part, amino-type, resin varnish currently being produced by only one manufacturer (Wm. Zinsser & Co.).

Vinyl-type wood finishes give you the drying speed of a lacquer with few of its disadvantages. They dry in a matter of minutes—15 in most cases—and may be sanded and recoated in as little as two hours. You can put on several coats in one day to complete a job in a matter of hours. In addition, if you’re refinishing old floors, furniture, or paneling, you don’t have to worry about the material underneath. These vinyls can be applied over old coats of shellac, lacquer, or varnish without causing lifting (but wash off all old wax or polish first).

The clear vinyls, unlike the lacquers, have little offensive odor. They thin with ordinary paint thinners (turpentine or mineral spirits) and you can wash your brush out with the same thinner. Like the lacquers, the vinyls are very clear, so they will not darken light woods or blond finishes. They also cost less than either lacquers or the urethane and epoxy varnishes—from \$6 to \$7 a gallon.

The two-part, amino-resin coating consists of a base varnish and a separate bottle of chemical hardener. It has a pot life of at least six months after the hardener has been added. Sold primarily as a floor finish, this heavy-bodied varnish costs about \$7.50 a gallon. It dries dust-free in 15 minutes and can be recoated the same day. Two coats give an exceptionally tough floor finish that, tests have indicated, will outwear practically all common floor varnishes and floor lacquers. In addition, it is unaffected by practically any household chemical or solvent. After a two-week curing period, even such powerful solvents as acetone, lacquer thinner, benzine, and ordinary paint remover will not harm the finish if you don’t allow them to stand more than an hour or two.

Like the vinyls, the amino-type varnish is very clear and will not darken or yellow with age. Because of its fairly heavy consistency, the manufacturer advises that it be thinned considerably before you use it on paneling, furniture, or other vertical surfaces. By thinning it, you’ll get better brushing and leveling properties and will be able to get a smoother finish. It won’t be as heavy (or as tough) a coating, but vertical surfaces, of course, don’t get the kind of wear that a floor does. At least two coats are usually required on raw wood—though three coats are best for use on pine or other soft woods. ■ ■



Make leg units first, dadoing No. 1 or 2 grade two-by-threes at 80-degree angles for cross laps. Cut seat cleats and fasten them across top of X by boring holes for carriage bolts.



For your private park:

A Man-Size Lawn Bench

EVEN a small yard takes on airs when you dress it up with this park bench. It's sturdy, straightforward, and comfortable. Since the plans call for stock lumber only, the bench is easy and cheap to build. How about a pair, to draw up to a picnic table?

Once the leg X's are made, dimensions can be fairly casual: Trim all cleats, the braces between the legs, and the back support to exact length after trial assembly. When you attach the back and seat planks, countersink and putty all screwheads for comfort and appearance. Finish with a cheerful color of outdoor enamel.—*Don Shiner.*

To establish height and angle of back braces, lay seat planks across leg units and tack braces in place. Clap scrap piece against edge of rear leg and scribe cutting line across brace.

Space back planks 1" apart. Leave $\frac{3}{8}$ " gap between two seat planks for drainage. Two-by-three cleat beneath center adds strength. Begin assembly with double rail between legs.



what's new

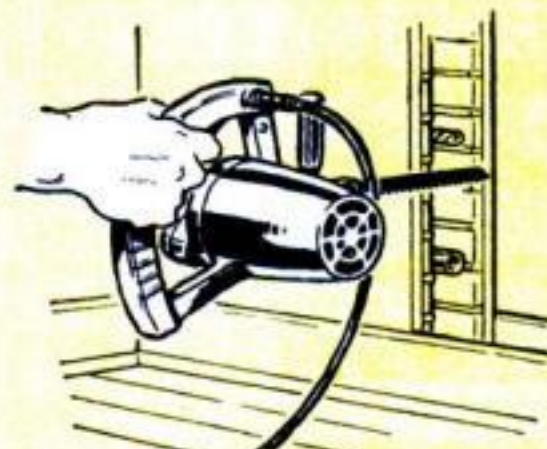
.....**TOOLS**



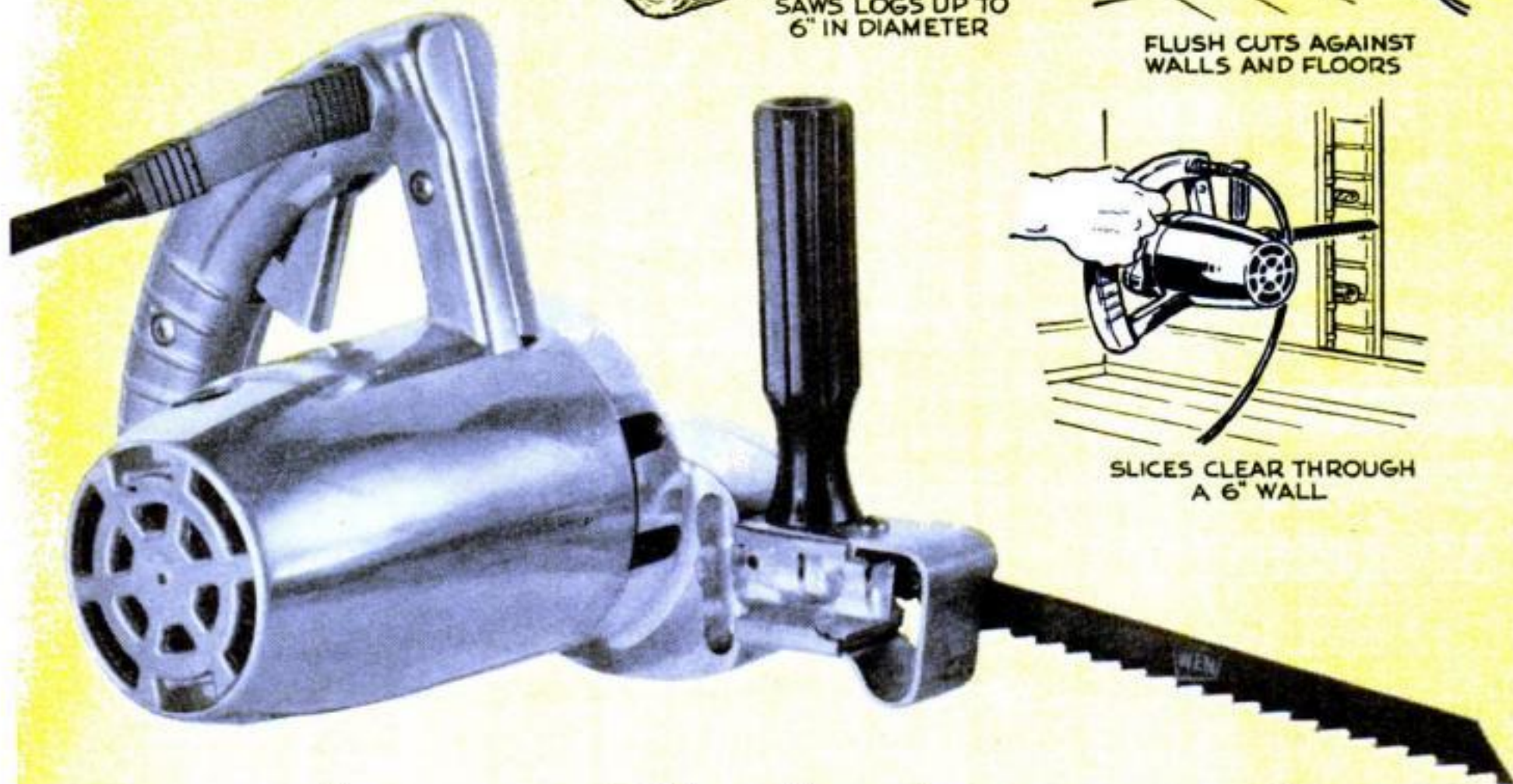
SAWS LOGS UP TO
6" IN DIAMETER



FLUSH CUTS AGAINST
WALLS AND FLOORS



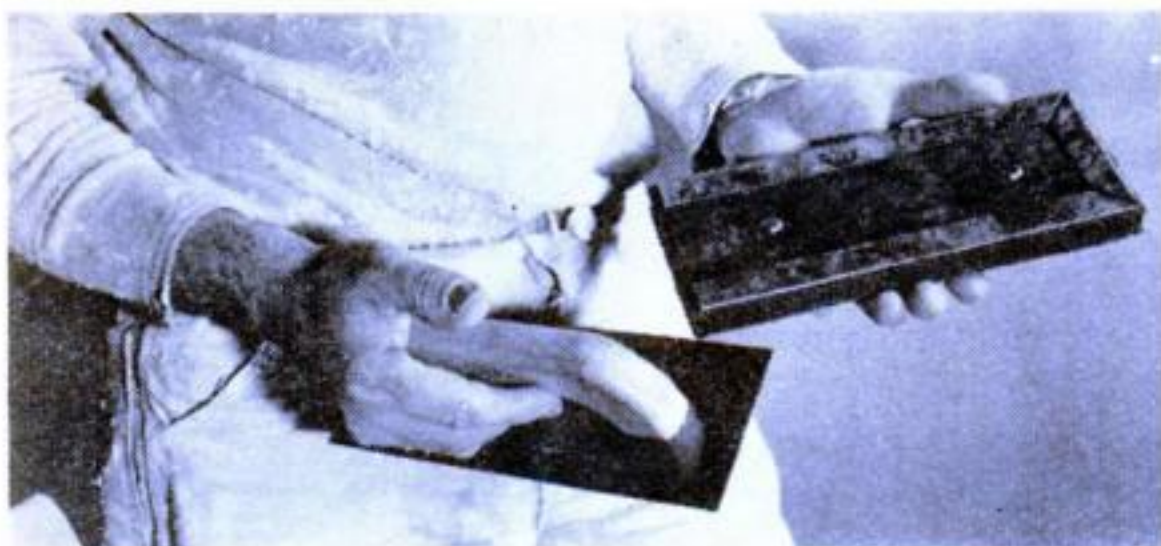
SLICES CLEAR THROUGH
A 6" WALL



Long-Blade Power Saw Has a 6" Bite

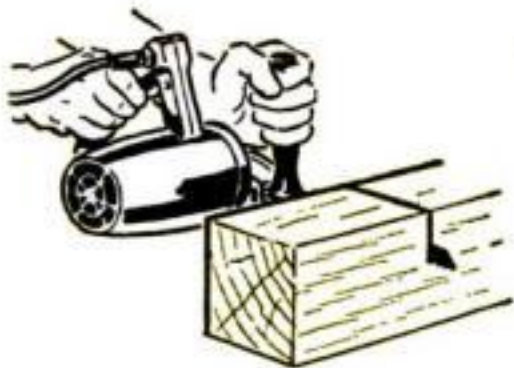
HERE'S a new concept in cutting tools. It looks like a cross between a power hacksaw and a portable saber saw—and, in fact, it will do the jobs of both. The horizontal blade design gives the tool the familiar feel of a conventional handsaw, but with the speed and ease of a power saw.

The saw weighs only 6½ pounds. It is both rugged and delicate. You can cut up logs in the back yard, chomp through pipe and steel plate, or jigsaw intricate patterns in scrollwork. Seven different types of blades handle heavy timbers, plywood, thick and thin metals, plastic laminates, composition boards, even soft materials.

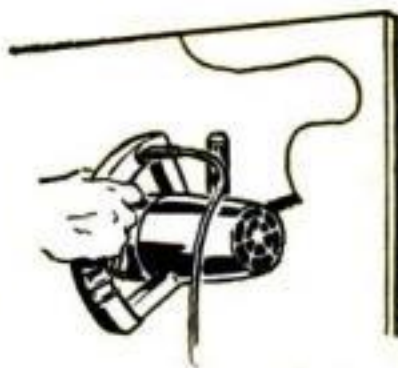


Quick-change float handle

This slip-on handle lets you carry or store several types of masonry floats in a small space. The floats come in plastic, cork, and rubber for plastering and cement jobs. Price is \$4.95 for the handle and three floats. Ernco Enterprises, Box 422, South St. Paul, Minn.



CUTS HEAVY TIMBERS
UP TO 6" SQUARE



MAKES SCROLL CUTS
IN ALL MATERIALS



CUTS PIPE AND TUBING
UP TO 2" IN DIAMETER



SHEARS THIN SHEET
METAL, PLASTIC, RUBBER

On thick materials, you can cut up to 6" deep. The $\frac{1}{8}$ -hp., 4 $\frac{1}{2}$ -amp motor drives the blade back and forth at 3,200 strokes a minute. In tests, the saw has sliced one-by-sixes in three seconds, four-by-four posts in 12 $\frac{1}{2}$ seconds, and $\frac{1}{2}$ "-by-1" steel bars in 30 seconds.

Unlike a conventional handsaw, the blade cuts on the backward stroke, pulling the saw's baseplate firmly against the work for steady control. The baseplate extends only along one side of the blade, leaving the other side clear for flush cuts against walls and floors. For internal cuts, the blade can be rocked into the work to start its own hole. In light cutting, you can guide the tool one-handed, like a hand-saw; in hard going, an auxiliary handle up front gives you a two-hand grip.

The tool, called the Zipp Saw, is made by Wen Products, Inc., 5810 Northwest Highway, Chicago. It will sell for \$44.95.

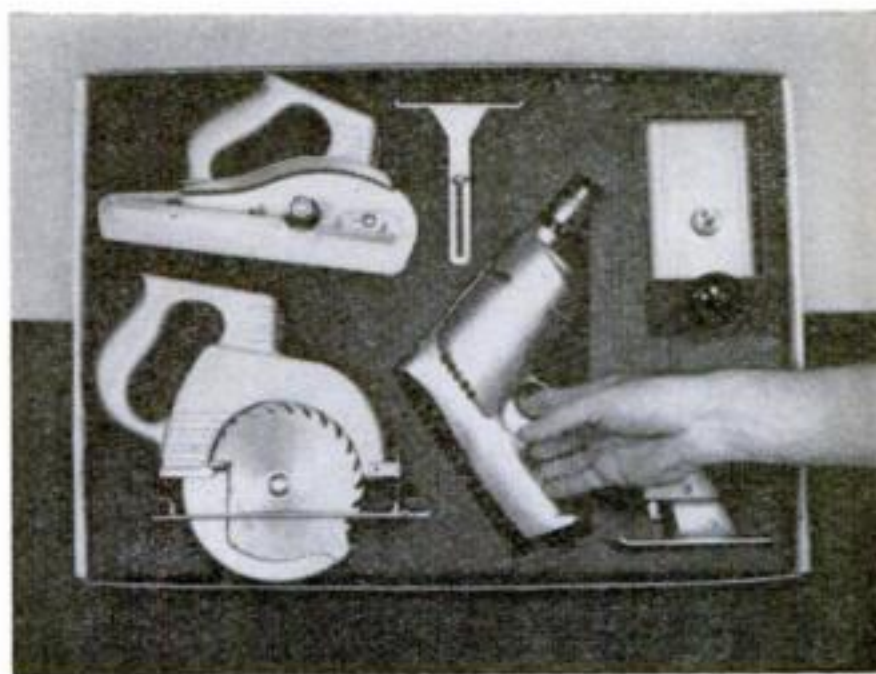
Drill-powered shop comes in a kit

You get a $\frac{1}{4}$ " drill and four matched accessories in this five-tool kit. The accessories are a rotary planer, 5" circular saw, orbital sander, and saber saw. The drill has an unusually slim pistol grip, said to be easy to grasp and control. The saw attachment has an adjustable baseplate for both straight and bevel cuts. The kit sells for about \$60. Dormeyer Div., 5610 W. Bloomingdale Ave., Chicago.



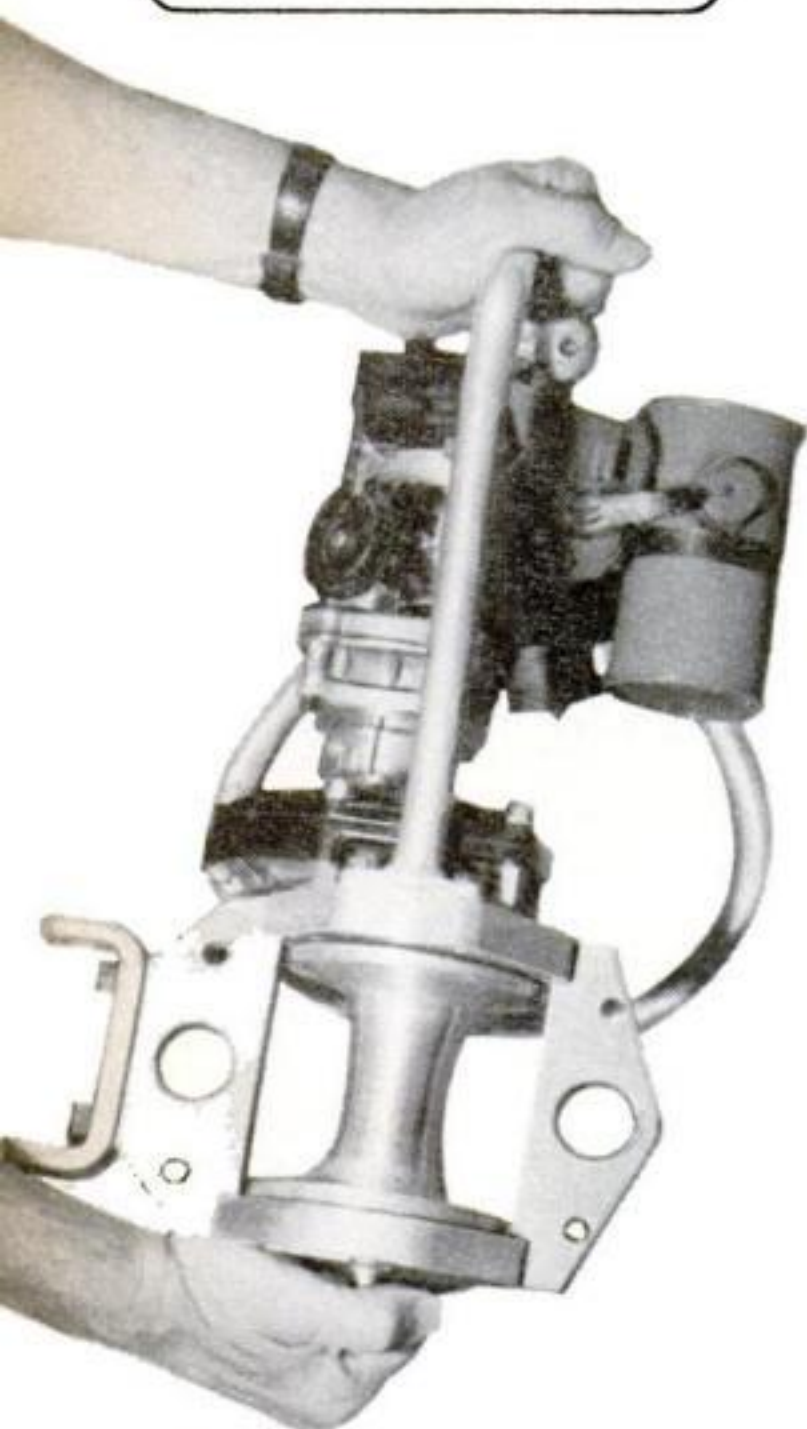
Snub-nosed $\frac{1}{2}$ " drill gets in tight spots

You'd never guess this was a heavy-duty $\frac{1}{2}$ " drill—it's not much bigger than a $\frac{1}{4}$ -incher. Its unusual chuck-over-motor design compresses front-to-back length to 5 $\frac{1}{4}$ ". The idea: You can squirrel the drill into hard-to-reach spots where bigger ones can't go. The handle, mounted at right angles to the chuck, is designed to give greater leverage against the backward twist of the bit. Two auxiliary handles are also available, a spade type that wraps around the back and a stud type that screws into either side. When a bit breaks through, the chuck can't hit and mar the work because it's recessed behind the front housing. A rubber bumper on the housing takes the brunt gently. The drill sells for about \$55; in a reversible model for about \$65. Stanley Tools, New Britain, Conn.

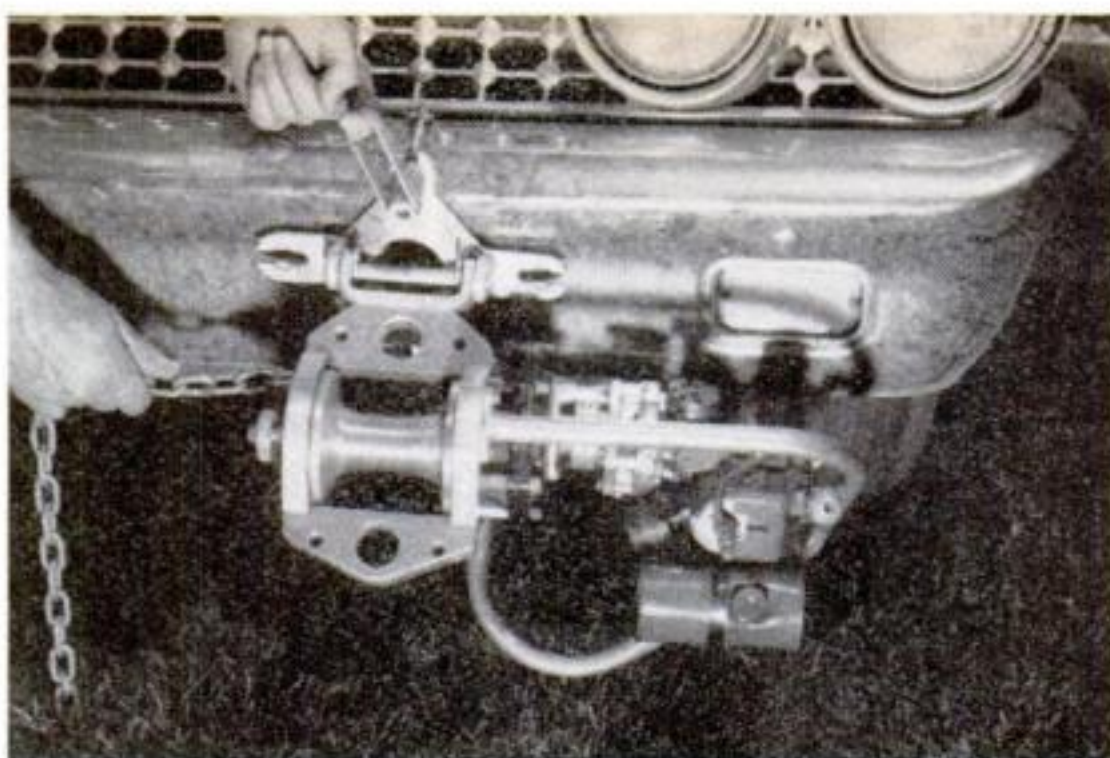


what's new

.....TOOLS



You just pull on the line to tighten it around the drum, and the winch picks up the load. A hinge pin in the baseplate allows the drum to adjust its angle to the line of pull.



Baby Gas Winch Lugs Big Loads

EVER wish for a portable winch small enough to carry out into the woods, toss in a car trunk, or stow in a boat? This one will do all that and more. It weighs only 16 pounds, yet will lift 70 times its weight—more than 1,000 pounds—on straight-up pulls and will haul up to 4,000 pounds on level pulls. In recent tests, it dragged a 3,300-pound car out of a mud hole without a wheeze and reeled a cabin cruiser smartly out of the water and onto a waiting trailer. It will also move boulders, lug trees and stumps, and handle heavy machinery.

The secret is a tiny $\frac{1}{4}$ -hp. gasoline engine that drives the winch drum through a hefty 155:1 gear reduction to give it muscle. The drum works like a ship's capstan. You merely loop a few turns of line around it and pull on the free end. The harder you pull, the tighter the drum grips the line. Slacking off on the line allows the drum to slip so you can control the load's speed of travel. Maximum speed, called recovery rate, is about 20' a minute. The drum will handle either rope or steel cable.

The winch is mounted on a slotted baseplate that can be lashed quickly with chain to irregular-shaped objects, such as a tree or car bumper. The chain is looped around the object, then hooked into the slots at the appropriate length. With the tool fastened to a car bumper and the line tied to a tree, you can winch yourself out of sand or snow. The tool can also be used with regular block and tackle to multiply its force still more, as for pulling stumps.

The Mini Winch is made by Irvington Machine Works, P.O. Box 6438, Portland, Ore. Price is \$169.

what's new

.....BOATING

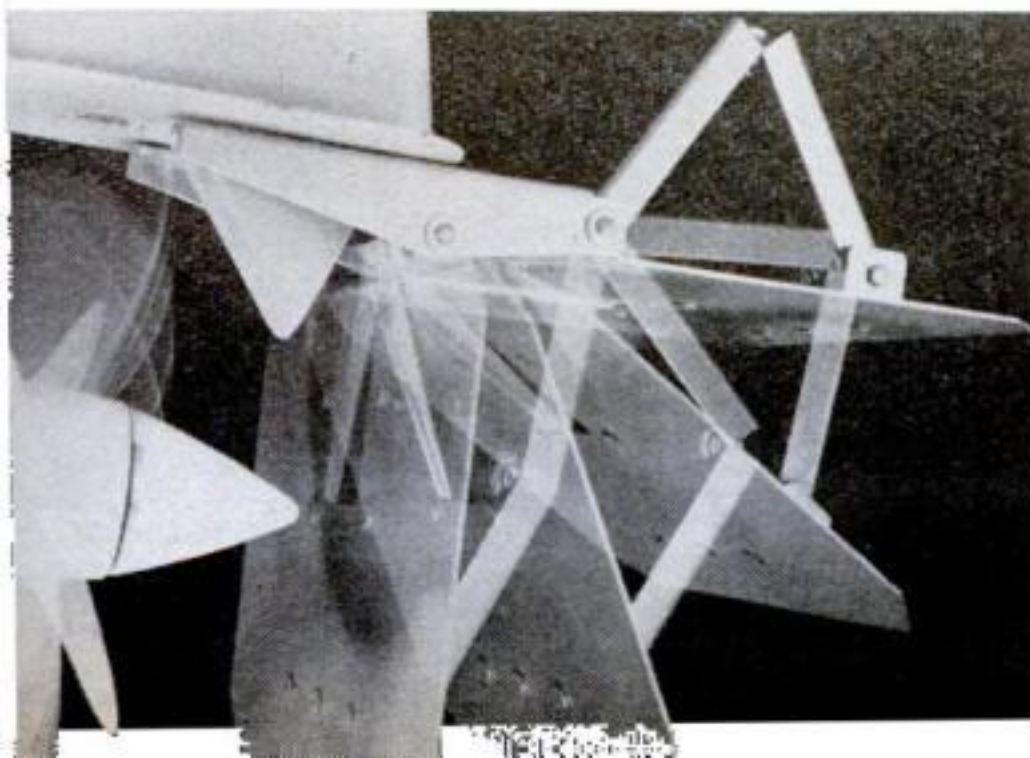
Electric hoist flips a boat in or out of water

Push a button and this motor-driven roof-top rig will swing any boat up to 250 pounds off a car and into the water—and back out again. It also lifts a heavy outboard on and off the boat. When you reach home, it raises both boat and unhooked carrier to your garage ceiling, storing the entire unit suspended. A reversible DC motor is run off the car's battery to drive a winch. The hoist is adjustable to fit all cars and wagons. Price is \$295. Stigum & Tweten, Inc., 5678 N. Lagoon Ave., Portland, Ore.



Trolling plate slows boat automatically

The pivoted plate shown below, attached behind an outboard, slows a boat for fishing. As you throttle down, Troll-Mate automatically swings down and locks. Pour on power and it lifts out of the way. It fits 15- to 100-hp. motors. \$14.95. North Coast Products, 333 W. Superior, Duluth.



Hook-together dock grows to any size

Hooking on one of these sections after another makes a dock as long as you want. The sections are lowered until plate-footed legs touch bottom. The aluminum frames take 4'-by-8' plywood panels or planks, are about \$40 each. Legs are \$15 to \$29. Alumidock, 2 Sheldon St., Randolph, N. Y.



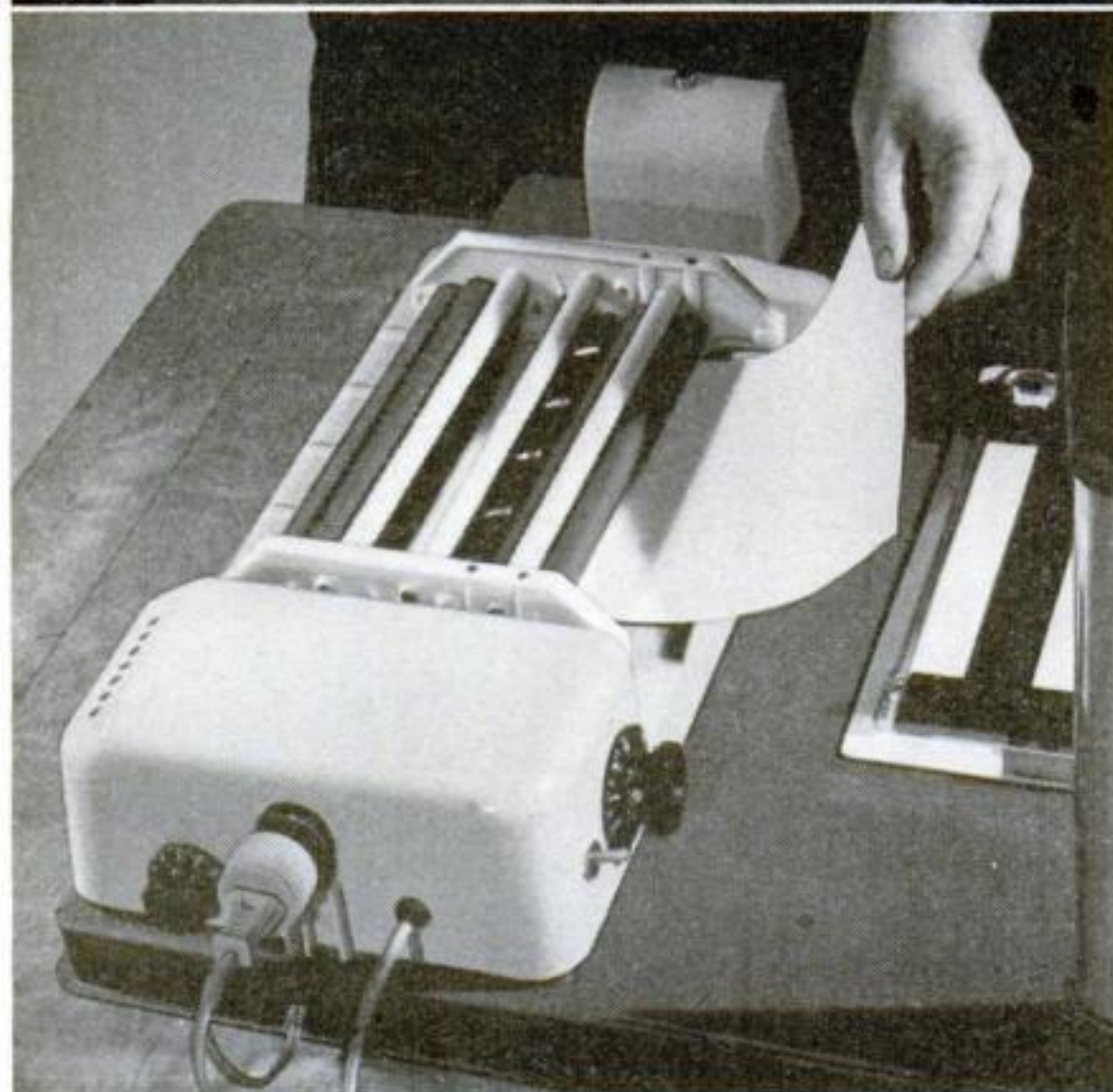


"Instant Darkroom" Turns Out Prints in Seconds

INSTANT darkroom is a bit of a misnomer—you don't get a darkroom by adding water. But you *can* produce finished photographic prints in a few seconds. You simply expose your negative on a special printing paper (either by enlarging or contact printing), feed the sheet into the processor, and the finished, damp-dry print comes out on the other side a few seconds later.

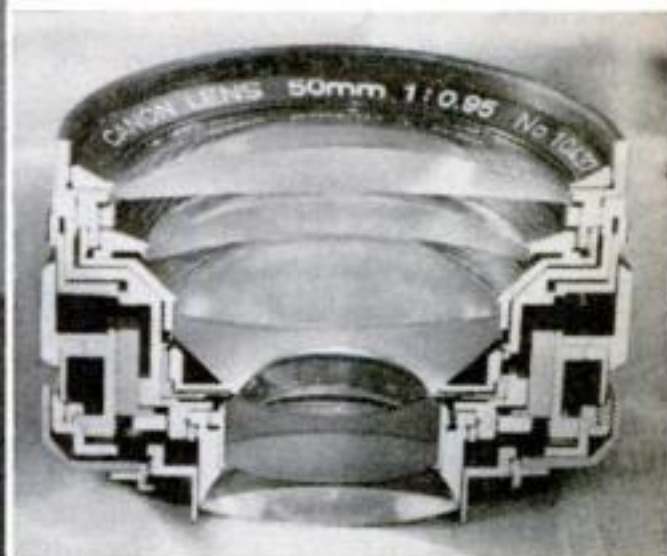
Motor-driven rollers convey the exposed paper through two processing solutions—an activator and a stabilizer. The actual developing agent is contained in the coating on the paper, but doesn't go to work until wetted by the activator solution. It is not necessary to wash the finished print. Solutions can be left in the processor, ready for use, for up to three weeks. The paper comes in a variety of surfaces for either enlarging or contact printing.

Complete with enlarger, automatic timer, processor, and a supply of chemicals and paper, the "Instant Darkroom" lists at \$299.95. The processor alone comes in three sizes: for prints up to 9 inches wide, 12 inches, and 18 inches. The nine-inch size is \$159.95. The machines and supplies are distributed by Federal Manufacturing and Engineering Corp., 1055 Stewart Ave., Garden City, New York.





what's new ..PHOTOGRAPHY



Super-fast lens almost sees in the dark

A lens faster than what was once thought to be the ultimate in speed is offered on Bell & Howell's Japanese import, the Canon 7, for just under \$500. Experts

long claimed that a lens with an aperture wider than $f/1.4$ would require an impractical combination of optical elements to correct distortion. The new $f/0.95$ lens (cutaway, above) excels in special effects with dim light and shallow depth of field.

Automatic camera corrects your errors

Newest Japanese 35-mm. camera—Fujica's Auto-M—boasts features that give it unusual versatility for an automatic. You set the speed that seems right for the shot. Should you guess wrong, a built-in electronic computer selects a new shutter speed after first attempting to compensate within the 2.8 to 16 range of f stops. When the light's too dim (or bright) for the film you're using, the shutter won't operate. You can then switch to manual and make a time exposure, or plug a flash unit into one of two sockets—for M or X synch. A special dial lets you stop down or open up one f stop on automatic setting. One disadvantage of automatics has been that



in-camera electric eyes don't let you expose for a particular detail. With Auto-M, you can walk in close to subject, press shutter release halfway, and back off to shooting position; camera "holds" close-up setting. \$89.95, Fuji Photo Optical Products, Inc., 111 Fifth Ave., NYC. Leather case is \$12.95.



Interchangeable backs for 35s

Now you can switch films mid-roll on Zeiss Ikon cameras without rewinding—and there's no danger of double exposure or skipped frames. To alternate between black-and-white and color shooting, you change film chambers. Extra backs: \$49 for Contaflex, \$55 for Contarex models.

▶▶▶ Latest color film is Type A Kodachrome II. It offers the same advantages over the Kodachrome it replaces as did the Daylight type, released last year: truer color, reduced contrast—and $2\frac{1}{2}$ times greater speed. It's designed for indoor use with photofloods at 40 ASA. Outdoors (with 85 filter) the ASA is 25. The carton says "Professional" because the film's offered in 36-exposure 35-mm. rolls only.

what's new

.....HOME
IMPROVEMENTS

Oil and Water Mix in New House Paint

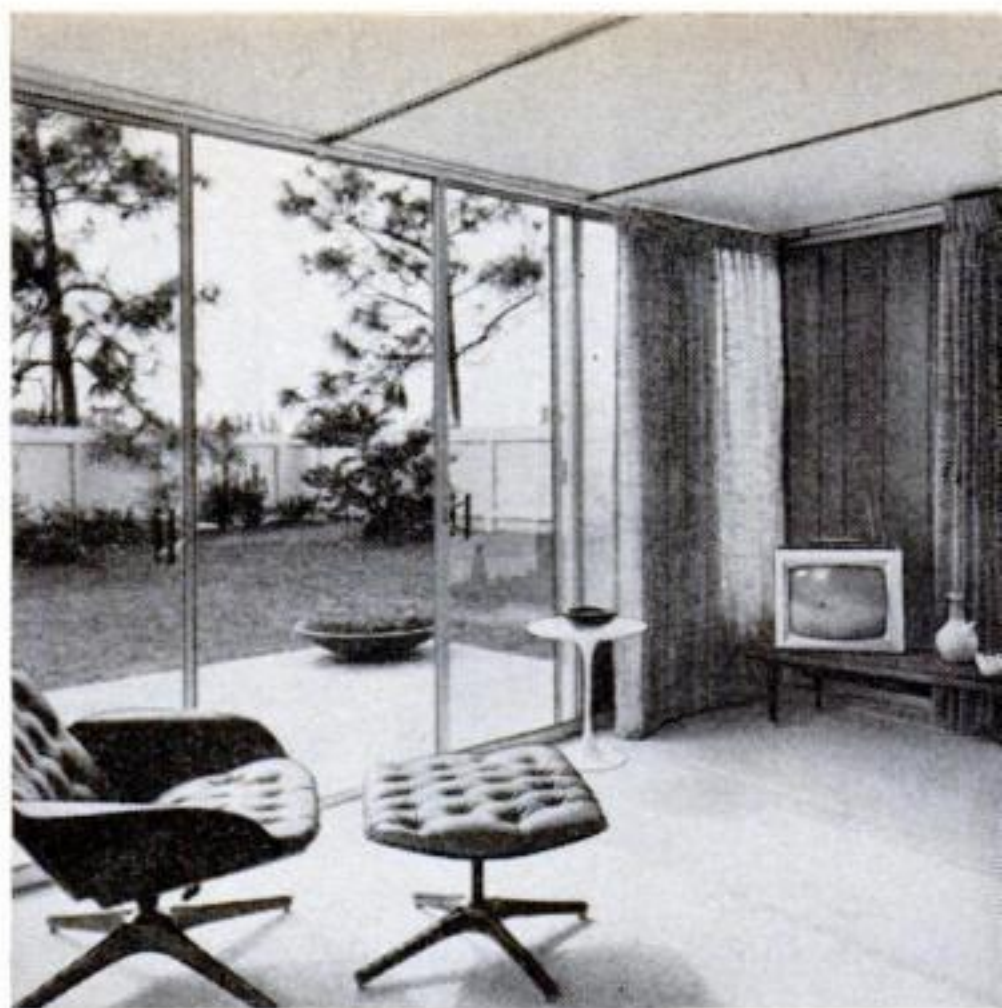
They've finally done it—made linseed oil water-soluble, ending the need for turps

By Alfred W. Lees

SCIENCE has done one more "impossible"—produced a linseed-oil house paint that's water-soluble in its liquid state. This means you can clean your brushes at the garden hose, rinse spatters off your skin and clothes, whisk up spills with a scrub brush. Though thinning is rarely needed, you'd use water for that, too.

Yet—here's the big news—once the paint coat sets, you've got the same tough film and good coverage that's always been characteristic of oil-base paints.

The brands already on the market include several from major paint makers. Many others will follow soon, particularly if there's as much consumer excitement as the trade expects. Though not all companies will admit it (apparently they'd rather imply that the new oil is a result of their own research) it's safe to assume that this remarkable new family of paints owes its existence to research conducted by a leading linseed-oil supplier, Spencer Kellogg. More than 10 years of testing in their Buffalo lab and in the field went into

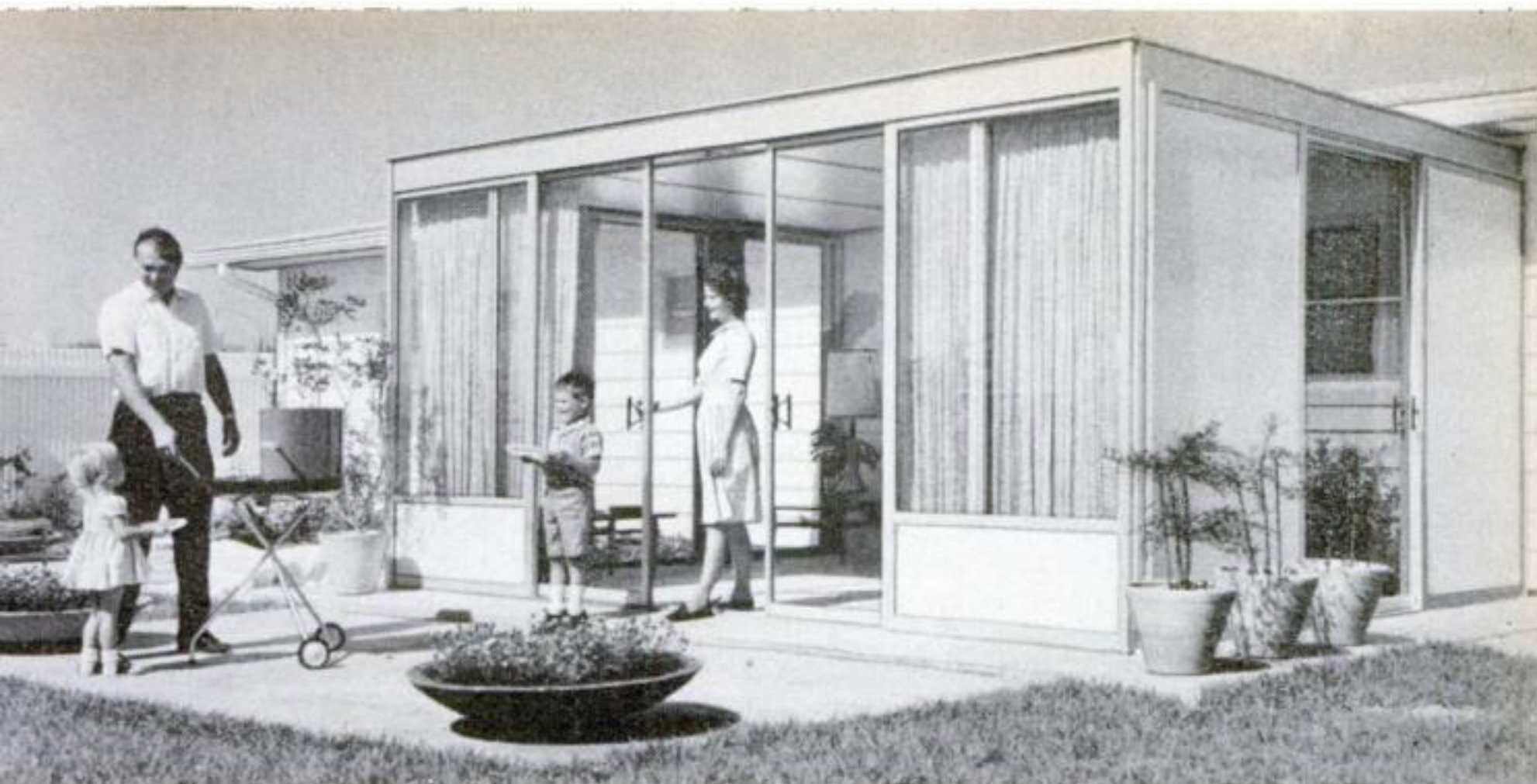


**Need more house space?
You can have it in a weekend
with this room-in-a-kit**



Prefabricated aluminum house

This house is mass-produced in modular units 8' high, 12' wide, and 14' long. Put together with concealed bolts, one or more units are used for each room. Walls are two sheets of aluminum filled with 4" of foamed-in insulation. After building, you can change the size of rooms by removing or rearranging partitions. The house shown has three bedrooms, a dining and living room, family room, kitchen, and patio. It costs \$12,000 to \$16,000 on your own lot (prices vary with carport, garage, or basement). Alside Homes, Box 1261, Akron.



YOU can order a new room from the mail-order catalogue. It's a do-it-yourself addition of aluminum wall and roof panels and sliding glass doors. The solid panels include built-in plastic-foam insulation and an interior facing of wood. With

one helper and ordinary tools, you can build a complete room on a concrete slab in a weekend. The rooms come with plain or double insulating glass in two styles and four sizes: 8' by 12' to 12' by 20'. Price, \$875 to \$1,995. Montgomery Ward & Co.



Bricks level themselves

These true-faced, concrete bricks stay level because there's no mortar between faces. They're bonded with a special grout you can apply with a paintbrush. It looks like mortar in the bricks' rabbeted corners. The bricks sell for \$62 to \$89 per thousand, depending on color and quantity. Tru-Lay Masonry Products Co., 2233 Hollywood Ave., Toledo, Ohio.



Underwater sealer

You can now dive into the pool to patch a leak. Alum-O-Bond sealer is so waterproof you can apply it under water. It sticks to wood, vinyl, aluminum, glass, rubber, and other surfaces. You can use it to repair downspouts, gutters, storm doors, and aquariums. Tubes come in 49- and 98-cent sizes. W. J. Ruscoe Co., 483 Kenmore Blvd., Akron, Ohio.



Fertilizer in sticks

Punch this fertilizer in at the base of a plant, and you feed its roots. Gard-N-Stik has an organic base for four formulas: 6-8-6 for annuals, and 5-4-4 for African violets and house plants, at 49 cents for 20 sticks; and 12-8-6 for roses, shrubs, and trees, and 6-12-12 for all your evergreens, at 98 cents per dozen. Gansco Products, 527 Madison Ave., NYC.

the development of a process that would chemically alter linseed oil so that it would mix with water. They've come up, too, with a neat name for this polyether-modified oil: Linaqua.

The secret is a soluble coupling agent that ties the oil and water molecules together into a solution. As the paint dries, the water and coupling agent evaporate, leaving behind a paint film almost identical to the one you'd get with a standard linseed-oil paint.

Linaqua paints are not the same as the water-base house paints reported on in the April issue of *POPULAR SCIENCE*. Those are *emulsion* paints, and have been around for several years. They were developed on the theory that if chemically made plastic emulsions could replace linseed oil in interior wall paints, they could be adapted to outdoor use, too. As the article pointed out, the theory was sound—except for certain limitations:

The primer problem. You can't get exterior emulsion paints to bond well to old chalked paint or dirty surfaces without applying a special primer (or first-coat additive). The function of this preparatory coat is to wet the chalk or dust to provide anchorage for the pigment. Water emulsion alone won't do it. And, since an emulsion-paint film is thinner than other types, it has less hiding power, requiring a second coat. If you pile on a double layer of pigment without a good bond, you invite the risk of peeling.

Then there's the matter of new wood—especially cedar or redwood, which require a sealer to keep their water-soluble stains from bleeding through paint. Bare nailheads need sealing, too. So, before you apply any emulsion paint, a primer or sealer is recommended for both chalked and new-wood surfaces. Ironically, this coat would have to be an oil paint, and this fact nullifies some of the advantages claimed for the finish coats—that they won't blister, for example. For these reasons, outdoor emulsion paints haven't won the ac-

ceptance that greeted the appearance of their interior counterparts. The new water-based house paints have this to fight.

Unlike emulsion paints, Linaqua types give complete coverage in a single coat—unless you're changing the color drastically. They adhere well to any normal painted surface, including one that's porous or highly chalked. For repaint jobs, *no* primer is required. There's a special water-soluble primer for bare cedar and redwood. Linaqua paints dry to a high gloss, and they can be mildewproofed with the addition of zinc oxide—a valuable quality since mildew is often the reason a paint coat looks dirty.

How the two types are alike. Aside from the water wash-up, there are other advantages the two water paints have in common: Either can be applied to a damp surface without waiting hours for the sun to dry off rain or dew. You just wipe off any droplets, dip your brush, and begin.

Both types set up fast; a few hours after application, either is impervious to a cloudburst. And both types offer easier brushing-out than regular house paints, with less bristle pull. Emulsion paints cop the prize here, though it's an advantage with a built-in hazard. They go on so smoothly that many amateurs overbrush them, leaving a film that's even thinner than the manufacturer intended. Average maximum coverage should be 450 square feet per gallon. You get about 500 with Linaqua paint, similar to oil-base-paint coverage.

In at least one exterior application emulsion paints remain superior—over comparatively new masonry and stucco. The reason? Non-oil paints are impervious to alkali.

For general use, however, the newer water paints bid fair to overcome the prejudices against the earlier types.

At any rate, science has rescued linseed oil from obsolescence. What *does* seem to be on its way out—where house-painting is concerned—is turps. Considering the smell, fuss, hazard, and extra expense it always brought to big jobs, few brush wielders will mourn its passing. ■ ■

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▶▶▶ A plant dwarfer retards chrysanthemum height while keeping the size of the flowers normal. Using it, you can grow long-stem varieties in pots. A \$1 package of Phosfon treats 30 plants. Virginia-Carolina Chemical Corp., Richmond, Va.

.....

▶▶▶ A chemically impregnated bar of wax helps you control grass between stones on terraces, walks, and at garden edges. One rubbing, and the foliage transfers the herbicide to the roots. A pound Dowpon bar costs \$3.35. Dow Chemical Co.

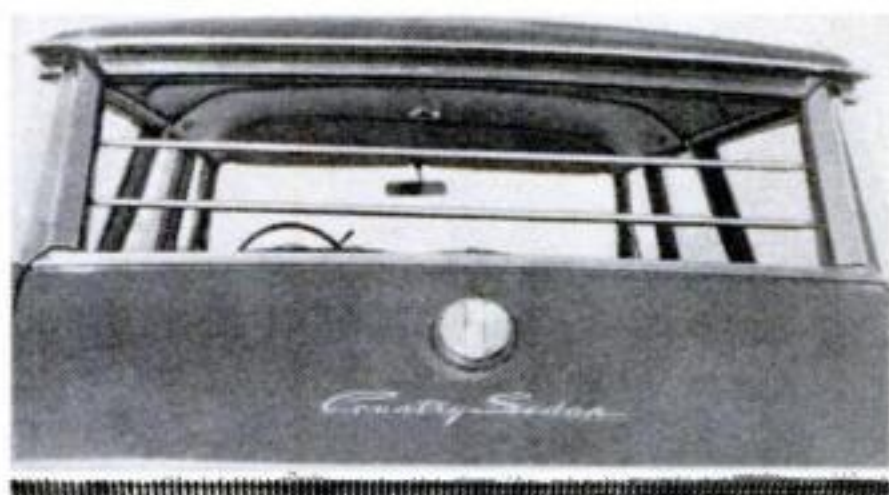


what's new

.....for your CAR

Rubber-faced guards protect bumpers

These rubber-and-aluminum bumper guards fit both American and foreign cars. "Sacred" guards are made in France and sold here by Madison Auto, 239 E. 47th St., NYC. \$7.50-\$16.50 each.



Bars protect station-wagon cargo

These two chrome bars keep kids, pets, and luggage from falling out the open rear window of your station wagon. Stay-Bars telescope and are held by spring tension. Mark D. Walsh Mfg. Co., P.O. Box 7113, North End Station, Detroit. \$12.95 a pair.

▶▶▶ A collapsible "squeeze" sign set up behind your disabled car warns approaching traffic to move over. It consists of a five-foot wire stand and cardboard arrow. Visibility up to 750 feet is claimed by Ward Green Co., 43 W. 61st St., NYC. \$2.95.



Adjustable nontipping food tray

Legs of this Car-Tray can be bent to fit any drive-shaft tunnel. Compartments hold food and beverages without tipping. New Products Co., 5654 Riverton Ave., N. Hollywood, Calif. It sells for \$3.89 postpaid.



Roof-top carrier puts lid on cargo

Over 16 cu. ft. of extra luggage space is provided by the completely waterproof plastic Newport Traveler. It measures 14 by 40 by 50 inches, has locks, and is easily attached. Newport Products Co., P.O. Box 1703, Newport Beach, Calif. \$79.95.



New KODAK Zoom 8 Reflex Camera, Model 2

Zooms you right into the

New Kodak focusing zoom lens keeps every zoom shot in razor-sharp focus from wide-angle to telephoto close-up.

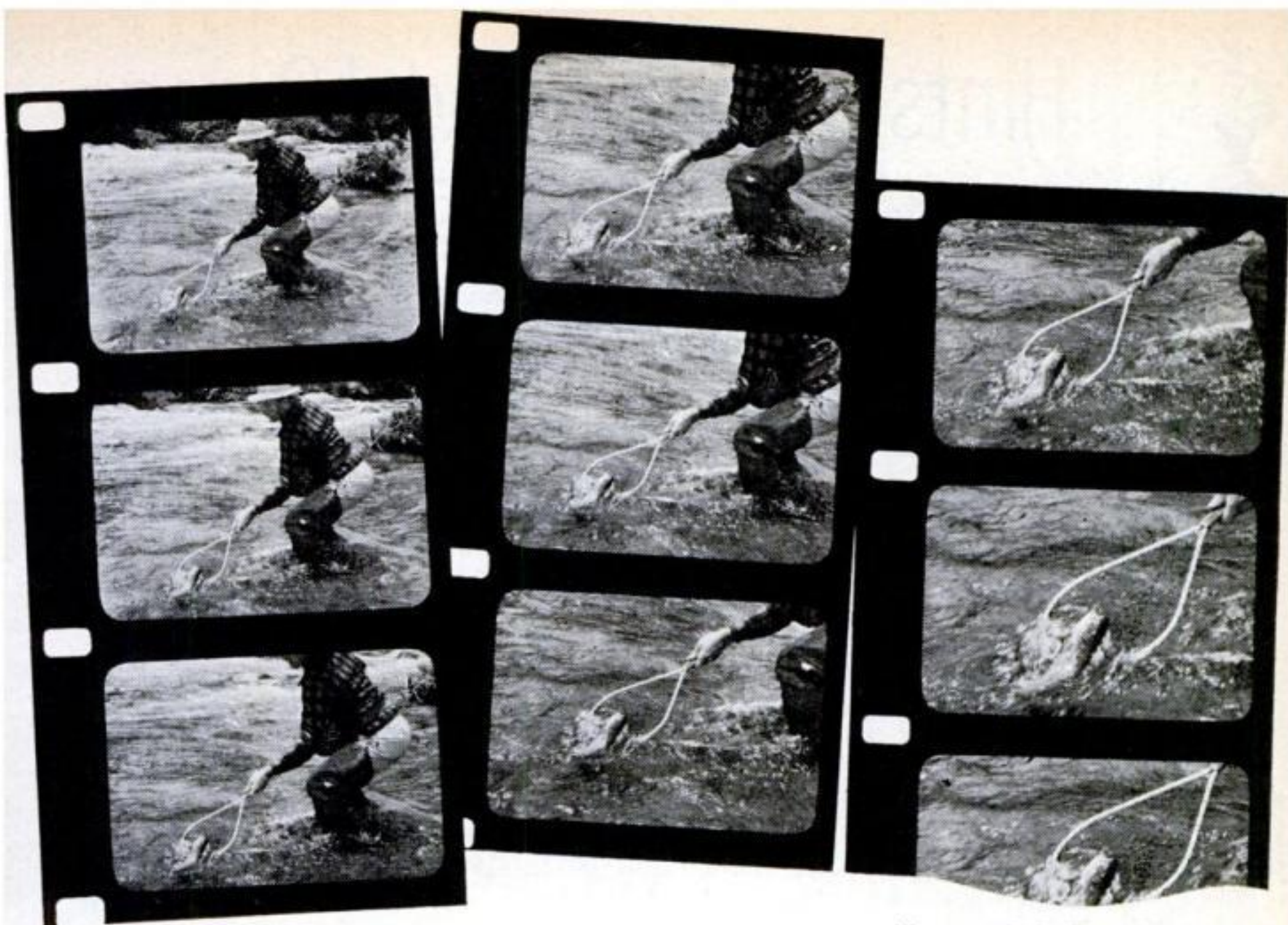
You can be in two places at once with this camera. Want to close in on that battle? Press the zoom button—and in you go, automatically. You see the action looming up right in the reflex viewfinder . . . big and sharp . . . just as you'll see it on your screen.

You'll take exciting, action-filled 8mm movies with the KODAK Zoom 8 Reflex Camera, Model 2. Sports movies, family movies, indoor movies. KODAK EKTANAR $f/1.6$ Zoom Lens focuses from 4 feet to the horizon to keep the action crisp, sharp. And you're fully in control. Just push the button down—you zoom from wide-angle to tele-

photo close-up. Push up—you zoom back. And you can stop anywhere in between. A manual control also lets you zoom fast or slow, lets you pre-set the lens anywhere from wide-angle to telephoto.

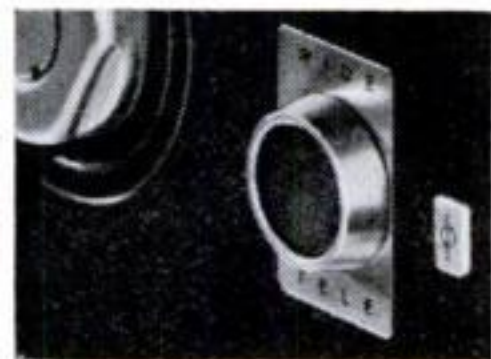
Electric eye sets lens, adjusts exposure continuously to the light, indoors and out, even warns when light's too dim . . . a rare circumstance with this camera's big $f/1.6$ lens and new, faster KODACHROME II Film. A special control also lets you lock the lens at any setting to shoot special effects.

Start getting the action around you on film! Ask your Kodak dealer to demonstrate the KODAK Zoom 8 Reflex Camera, Model 2, and see how exciting movie-making can be! Less than \$215. Or as little as \$22 down at most dealers'!



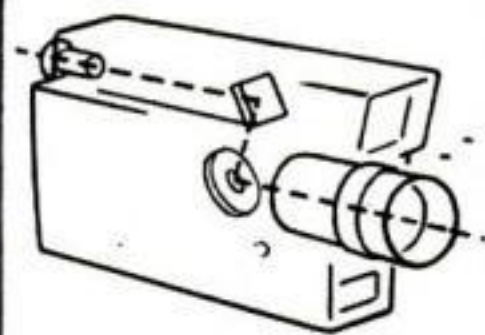
All on a single film wind! Wide-angle to telephoto close-up! And all done automatically . . . with the KODAK Zoom 8 Reflex Camera's powered zoom button!

splash of a trout battle!



PUSH-BUTTON ZOOM

Push down . . . zoom from wide-angle to telephoto close-up. Push up . . . zoom back. Stop anywhere in between. Power operation is smooth and steady.



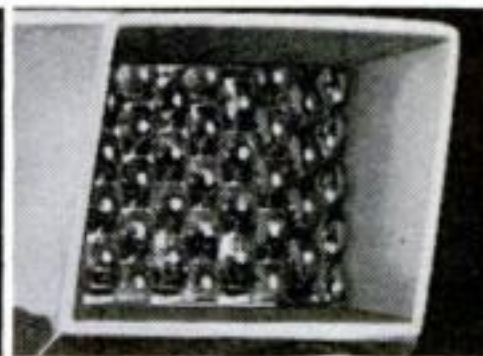
REFLEX FINDER

You view through the lens, see exactly what the lens sees, close-up or far away! Eliminates parallax problems . . . no chopping off heads in close-ups.



FOCUS-SETTING RING

Just dial camera-to-subject distance and you get movies sharp from 4 feet to infinity. There's also a universal focus setting for fixed-focus shooting.



ELECTRIC EYE

Continuously adjusts the lens to the light. When there isn't enough light, a signal in the viewfinder warns you!

Price subject to change without notice.

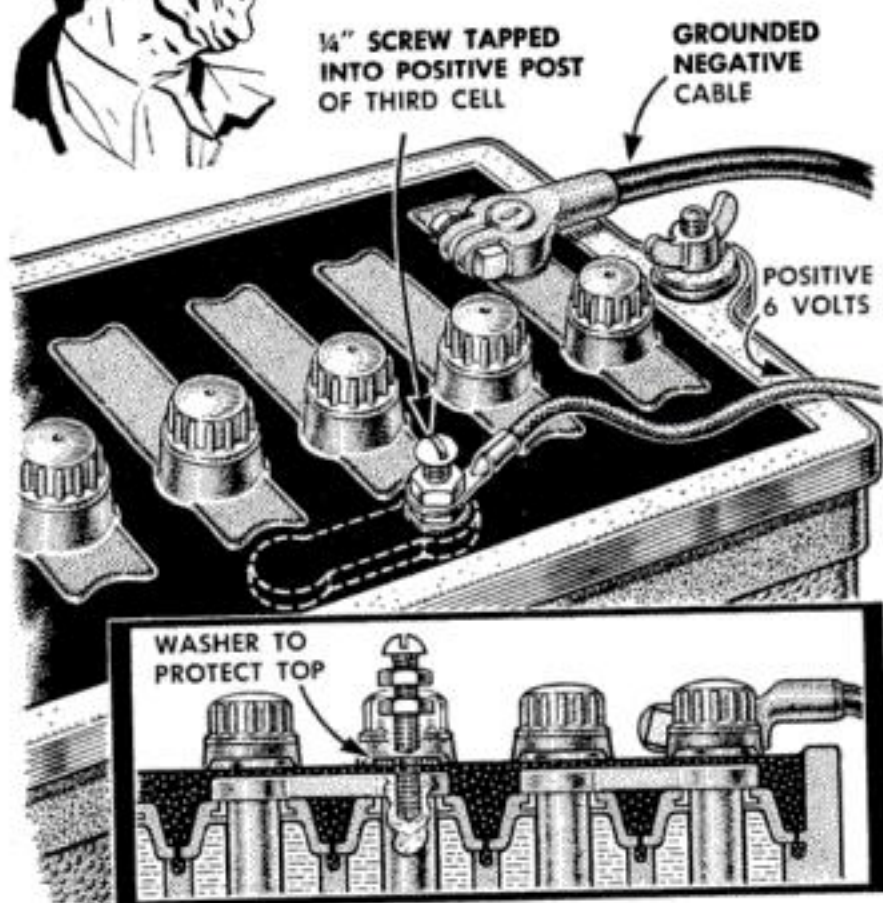
EASTMAN KODAK COMPANY, Rochester 4, N. Y.

Enjoy Walt Disney's "Wonderful World of Color" Sunday evenings, NBC-TV

Kodak
TRADE MARK



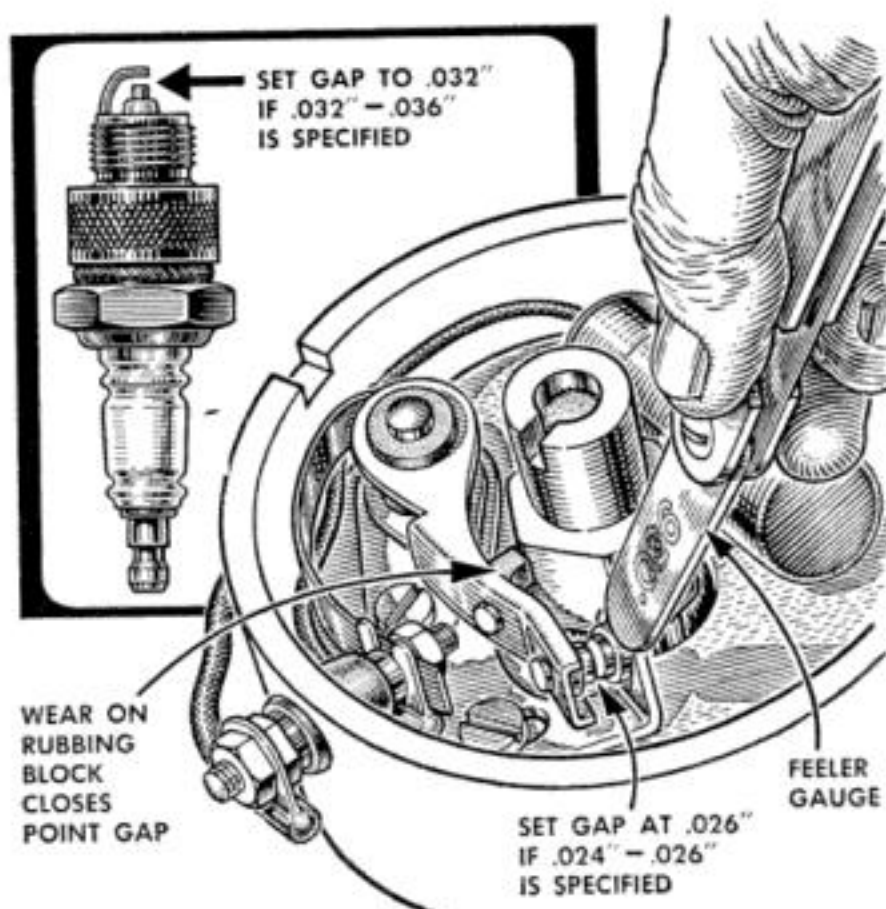
Hints from the Model Garage



Tapping a 12-volt battery is cheaper than buying a resistor when six-volt current is needed for electric brakes on trailers. Drill a hole in the positive post of the third cell and install a $\frac{1}{4}$ " screw to act as a terminal for the six-volt cable lead.



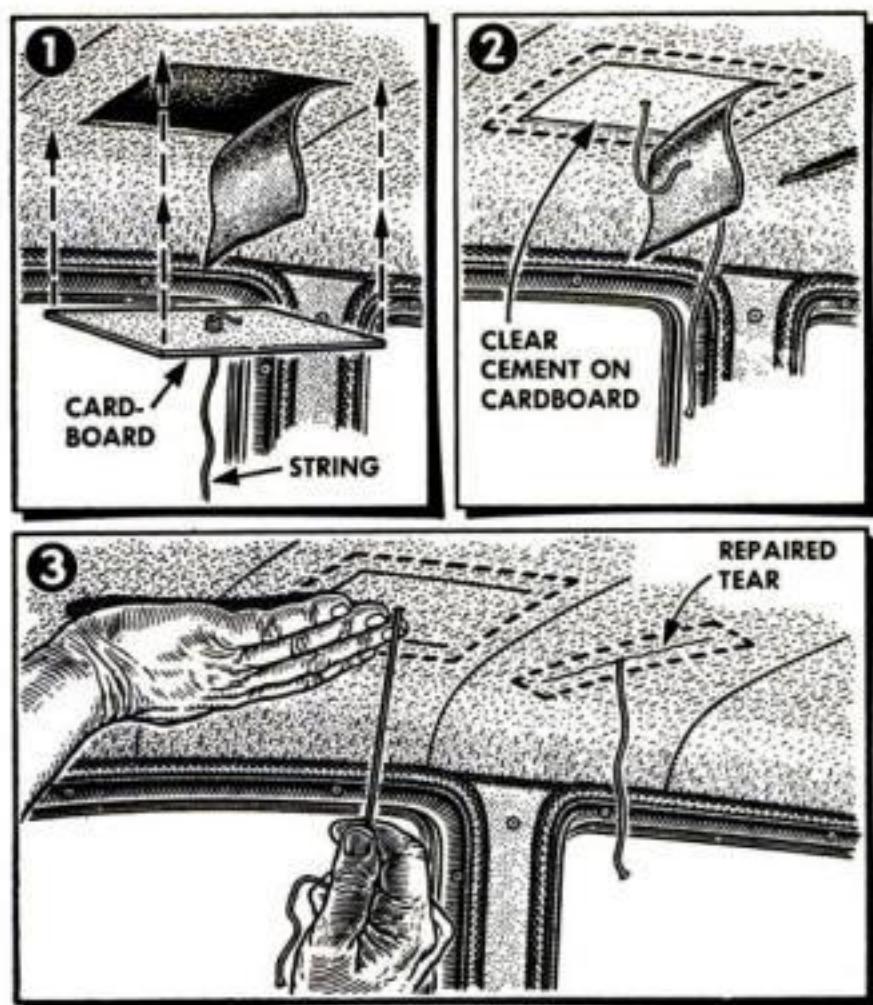
Touch up paint chips and scratches with a nail-polish brush. It's just the right size and its handle is conveniently shaped for detail work. First clean the brush with polish remover. Promptly taking care of chips prevents rusting and blistering.



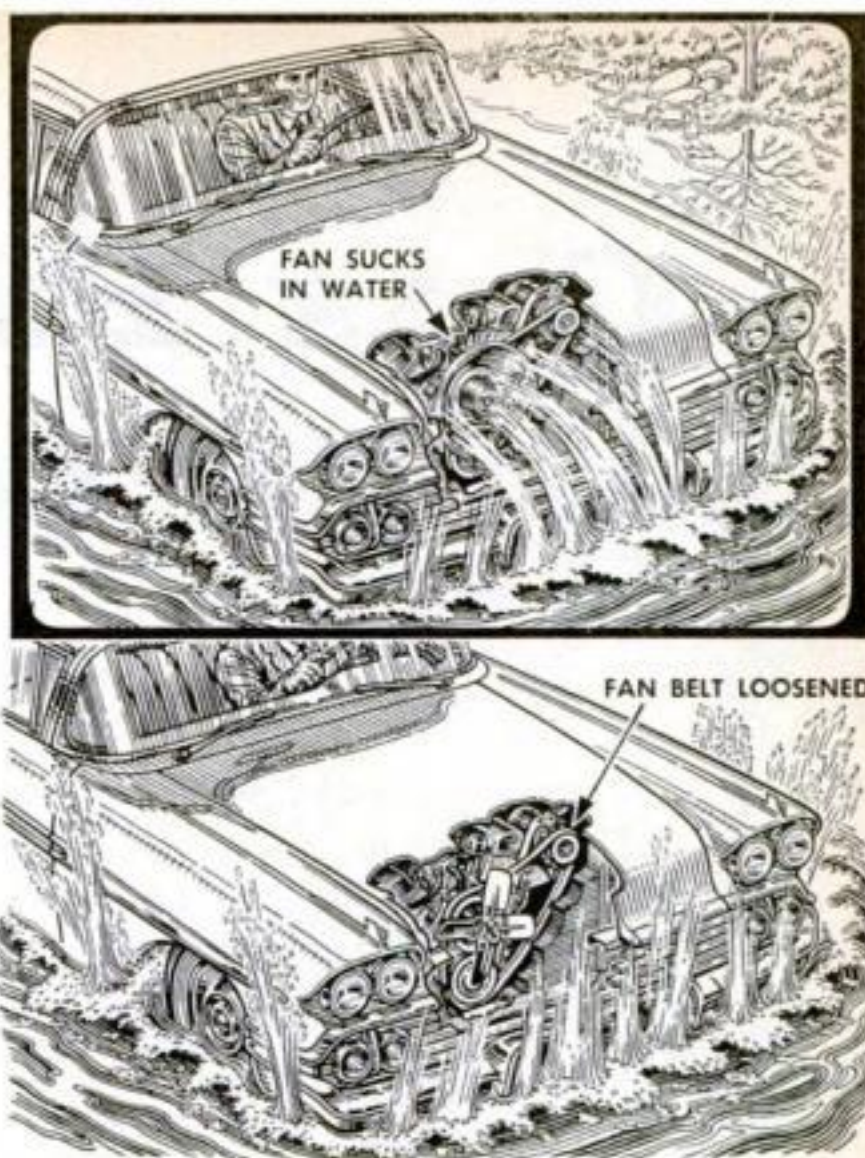
Adjust spark plugs to the smallest gap recommended. They'll stay properly adjusted longer since their gaps increase with service. Distributor points, however, should be set at the high end of recommended range since their gaps decrease with wear.



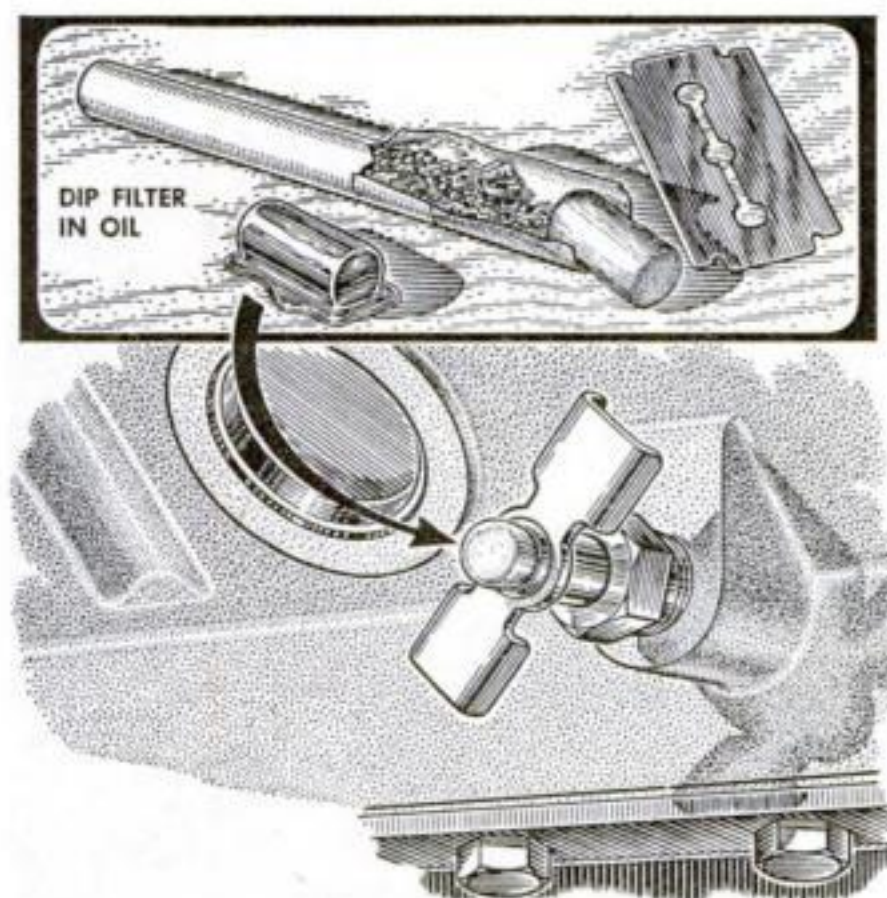
An old blanket can keep you clean when you unload your car trunk. It protects clothing from grime on the bumper. Fasten the blanket to the trunk floor, and sew a wooden slat into the edge to prevent flapping. The blanket rolls up when not in use.



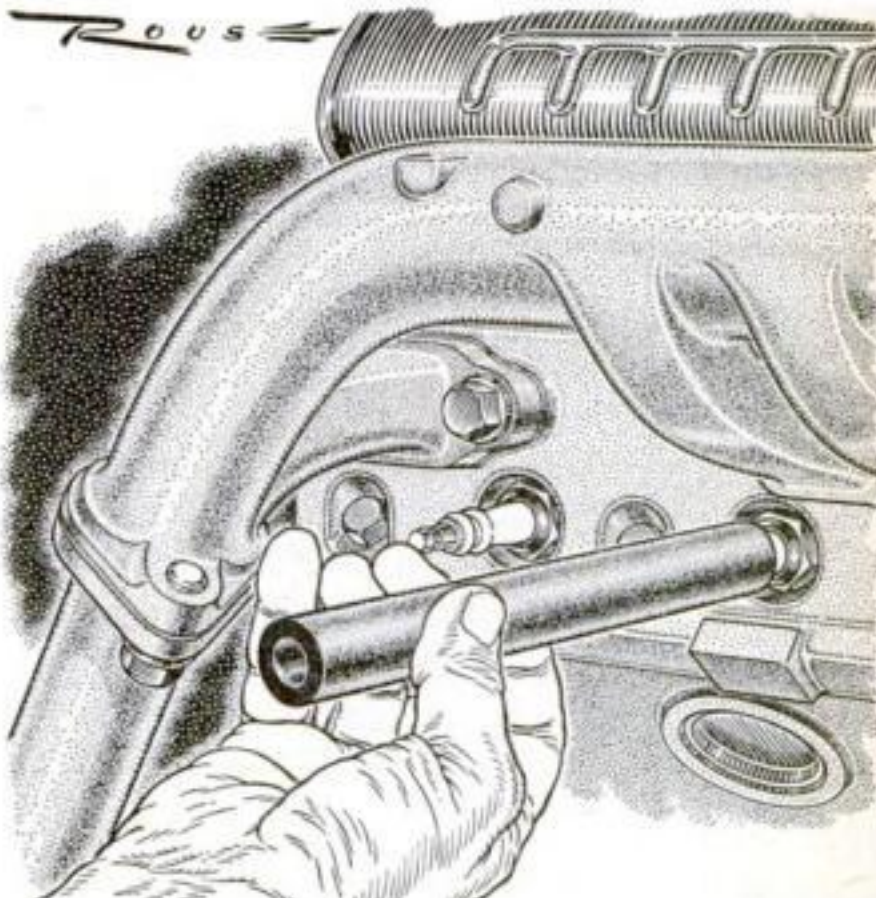
To fix headliner rips, knot a cord through stiff cardboard larger than the damaged area (1). Slip cardboard through tear and run cord through torn flap (2). Apply cement, pull cord, press cloth against cardboard (3). When patch is dry, snip cord.



Engines often wet out when driven through a flooded roadway. The radiator fan usually is the culprit; it sucks up the water and throws it back onto ignition wiring. Next time, loosen the fan belt so the fan doesn't turn. Reconnect it on dry ground.



Dirt won't clog petcocks on radiator and engine block if you insert cigarette filters that have been soaked in oil. Leave $\frac{1}{4}$ " protruding. The filters also prevent messy dripping and keep hands dry while you're opening the petcocks to drain the water.



You can remove hot spark plugs without burning your hands by means of a piece of garden hose. Loosen the plugs with a wrench, slip on an 8" section of hose, and unscrew them. If plugs are small, slip hose over base and bear down while turning.

Gus Picks Up Three of a Kind

By Martin Bunn

BROKEN any laws lately, Boss?" Gus Wilson looked quizzically at Stan, his assistant. "With so many on the books, who knows? Why?"

"Chief Eldon just parked outside."

Sam Eldon, a lean man in a loose-fitting uniform, whose sagging jowls gave him the appearance of a downcast bloodhound, entered the Model Garage.

"Hi, Sam. Would a cup o' coffee lighten this dark day for you?" asked Gus.

The Chief of Police tilted back his gold-braided cap. "If that tar you brew doesn't kill me. Let's try it."

Mugs in hand, they looked at each other in the comfort of Gus's office.

"Sure is a dark day when I have to ask help from an old fraud like you, Gus," began Eldon morosely.

"Always ready to help you keep the job you got by cheating on the police-school exams," retorted Gus amiably.

"Got a problem concerning a customer of yours—Silas Barnstable."

Gus grinned. "We both know Silas. What's his squawk this time?"

"Silas wants to charge young Tommy Barnes with malicious mischief on his car. Tommy had means, motive, and opportunity, so I've got to look into it."

Gus frowned. "What's it all about?"

"You know the Barnes house is next to Barnstable's, with driveways side by side. The kid works on his hot rod in his. A week ago, the muffler blew out; the car made quite a racket."

"He came in here and bought a new muffler about then," said Gus.

"I know. Barnstable came demanding that I arrest Tommy for disturbing the peace. See what I mean by motive?"


"No, I don't," said Gus. "Tommy'd hardly damage Silas's car for that."



"It's motive," said Eldon. "Barnstable just got a secondhand Plymouth six. Day after I warned Barnes, this car was in Barnstable's drive. When he went to start the engine, there was some kind of explosion under the hood. Then he noticed Tommy watching. 'Grinning like a fiend,' as Silas put it."

"Did the car start?"

"No. Silas looked under the hood. Some-



"Sure is a dark day when I have to ask help from an old fraud like you, Gus," the police chief said.

thing had blown off the distributor cap. He made me look at it. There was no paper, wadding, wire, or anything else from a detonator. I put the cap back on. The engine started.

"Now what I want to know, Gus," said Eldon with a lugubrious expression, "is whether you've run across any such thing that plainly wasn't sabotage?"

"Sure," said Gus promptly. "On the same

model, three or four years old. What usually makes it happen . . ."

"Stow it!" interrupted Eldon, getting up. "All I need to know is that it can happen innocently." The shrewd hound's eyes gazed at Gus. "Same model, hey? I'm going to tell Silas to shut up."

An angry horn blast brought Stan out from under the car lift as a dust-covered

panel truck rolled in to a stop beside him. "Anybody awake here?" snarled the beefy young driver.

Stan checked a retort. "Anything we can do for you?"

"We?" The youth looked around. "I suppose you've got ten mechanics, only the other nine are out to lunch? You can fix my left-hand blinker. Go look."

He jerked a thumb backwards. Going around the car, Stan saw the left tail light come on and glow steadily under encrusted dirt. As it went out, the right one began blinking.

"Got it?" asked the driver. "Right, yes; left, no. Fix it. Cop in your jerkwater town tagged me for not signaling a left turn. And I've got eight deliveries to make here."

Stan checked the wires. None were crossed at the flasher or shorting to others. "Bulb could be bad," he said.

"Just put a new one in myself. Try another flasher."

Stan did. The left-turn signal and its mate up front lit but did not blink. He tried the parking lights. Both lamps glowed under the dirt-covered lenses.

"I told you both filaments are okay," growled the belligerent youth.

Stan rechecked the wiring and flasher connections. He had found nothing wrong when Gus returned from lunch.

Stan explained the problem. "I'd say he put the bulb in upside down," he finished, "except that it's the kind of offset pin you can't put in wrong."

"Take off both those dirty lenses and look again," Gus suggested.

Stan removed them. The left lamp burned more brightly than the right. He switched off the parking lights, had the driver hold down the brake pedal. The left stop light was dim, the right bright.

"Would you take out that bulb you put in?" Stan asked the driver.

He tried. Surprised, he grunted, put a glove on his hand, and tried again. The little

glass globe didn't budge. He shook his head and glared at Stan.

"Crummy socket's shot; I had a devil of a time putting that bulb in. Why should I take it out?"

"Because you bullheaded it in upside down!" snapped Stan. "It should be impossible—the base pins are spaced to fit stepped slots in the socket—but you did it. I'll have to break the bulb to get it out."

"So leave it! It lights up on the turn signal. Just make it flash."

"The flasher takes a certain amount of current to make and break. This low-candlepower filament doesn't pull enough juice to work it. You want the bulb put in right or not?"

Gus, his back turned, said nothing but mentally applauded. Five minutes later the left-turn signal worked fine.

"SERGEANT GILL speaking," said the phone in Gus's ear. "Chief Eldon asks if you'd come to the Barnstable house."

Gus groaned, but five minutes later he was at Silas Barnstable's.

Next to the chief's car stood a truck from a new cut-rate garage. Its overalled driver as well as Chief Eldon and Silas Barnstable, sour-visaged as ever, were waiting alongside Silas's car. A little apart was skinny, tow-haired Tommy Barnes, trying not to look scared.

"Meet Ed Hickson, Gus," said Eldon. "Silas wanted his own expert."

The stranger waved a hand.

"Half an hour ago," Eldon went on, "Silas happened to look out here . . ."

"Happened? I was watching, 'cause I knew he'd try again," growled Silas.

". . . He saw Tommy crawl under his car and stay several minutes. So he called me. When we tried the engine, something blew off the distributor cap. We're here to find out if Tommy's responsible."

"I'm not!" protested Tommy. "One of my chromed head nuts fell and rolled under his

Where'd it come from?



"Mind your p's and q's"

These stern words weren't always delivered by schoolteachers to pupils, or parents to children. They were, in fact, the customer's admonition to the English barkeeper when he served a glass of ale or bitters that he measure out the full content of the English pint or quart.



Rambler American "400"—equipped with Champions—wins Class "A" in the Mobil Economy Run, delivering the best gas mileage of any car in any class!

For top economy and performance, twice as many car manufacturers the world over (including Rambler) specify new silvery-plated Champion spark plugs. Why settle for less in your car?



CHAMPION

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car. It took me that long to find it." He held out a gleaming nut.

"Bah!" rumbled Silas. "He reached up and did something to my engine."

Eldon turned to Hickson. "You think this cap could blow off by itself?"

"Not likely. That story about a lost nut sounds pretty thin to me . . ."

"You're not here to judge that," snapped Eldon. "Could it happen?"

Hickson shrugged. "If a breather's plugged, or there's blowby past the rings, crankcase pressure might come up the distributor shaft. I've fixed it by drilling a one-eighth hole in the cap to let the pressure out."

"But," he added with a side glance at

"Oh sure, this car pulls gas into the distributor!" sneered Hickson.

Silently Gus pulled off the distributor and, as the others watched, took off the vacuum advance. Carefully he opened this to expose the diaphragm.

"Take a real close look, Chief."

The chief did so. "Looks like a lot of pinholes in the diaphragm."

"One side of it's connected to the intake manifold," explained Gus, "so cranking the engine can send gas vapor to it. Some gets through those pinholes into the distributor. When there's just enough gas and air, the spark at the points can set it off."

"Hickson fixed that," said Silas hotly.

"What do you think I'm paying him for?"

"No, sir—the hole drilled in the cap only keeps the explosion from blowing the cap off," replied Gus.

Chief Eldon turned to Silas. "Still want Tommy booked?"

"I—uh, no. Seems maybe I'm wrong."

Gus laid the vacuum advance beside the detached distributor.

"Hey, now!" roared Barnstable. "Who's going to put my car together?"

"Maybe Gus will," said the chief. "After you've paid him for a road call."

"I'll take care of it," put in Hickson. "That'll be five bucks in all."

"Bill me some year!" snarled Barnstable. "Next time I want another botch job, I'll look you up. . . . Hey, Gus!"

Gus, on the way back to his car, paused and turned around.

"I'll pay you for coming out if you'll put on a new vacuum diaphragm," whined Silas.

Gus grinned. "Bring it in next time you're in town."

Silas turned on what he believed to be an ingratiating smile. "Now don't overcharge me because I made a mistake about young Barnes," he pleaded.

"Okay, Silas," Gus said with a sigh. "But you're the third today."

"Third? Third what?"

"Screwball," said the grinning chief.

"Stan had the first," said Gus. "Hickson with his hole-in-the-cap cure was the second. You're the third to have all the facts but insist on putting them together upside down." ■ ■



Silas, "I checked the compression on this car before Mr. Barnstable bought it. Rings are okay and the breather's clean."

"How about that, Gus?" asked Eldon. "Is he right?"

"How could there be back pressure," asked Gus, "before the engine has started?"

"Maybe cranking does it," said Hickson quickly. "Anyway, these sixes have weak distributor clips. I've had to bend 'em back to hold the cap tight."

"Let's try our luck and see if it happens again," suggested Gus.

Gently bending a curve back into the straightened clips, he put on the cap. At a nod from Eldon, Silas cranked the engine. There was a small explosion. The cap lifted, settled back under the clips.

"Lucky!" exclaimed Gus, snapping off the cap. Blue smoke drifted up.

"Smells like exhaust!" said Tommy.

"Why not?" asked Gus. "It's from an explosion of gas vapor and air."

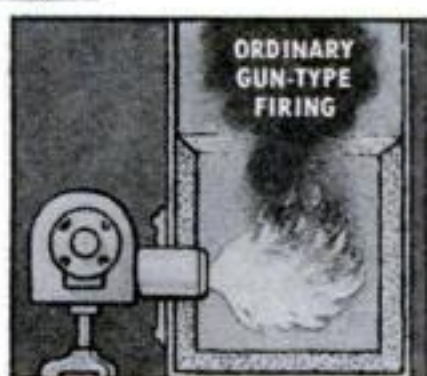
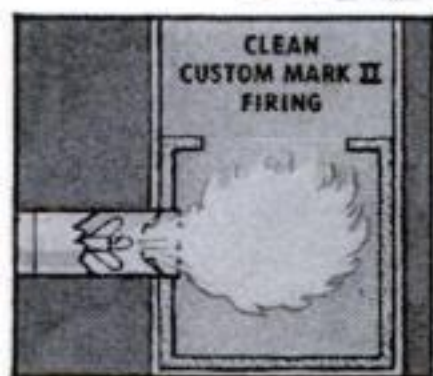
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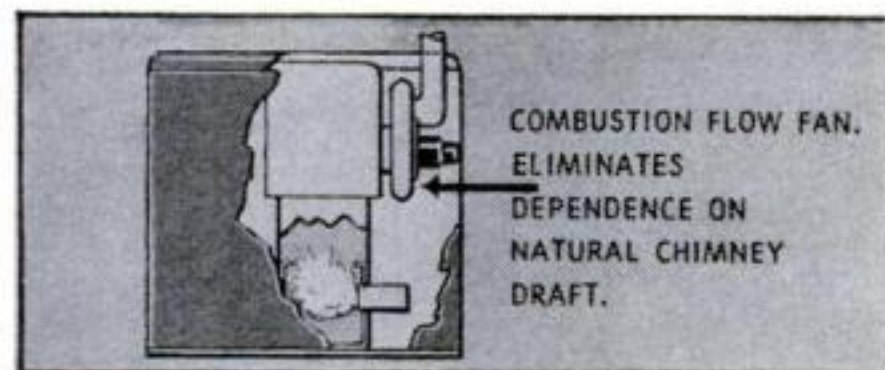
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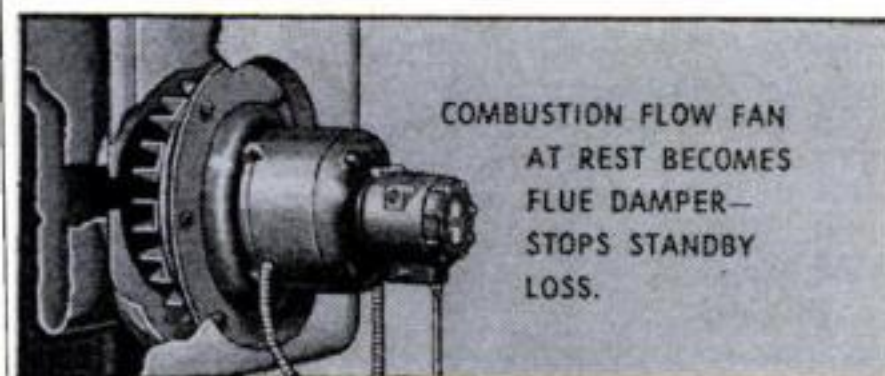
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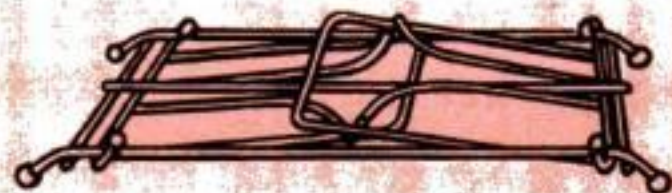
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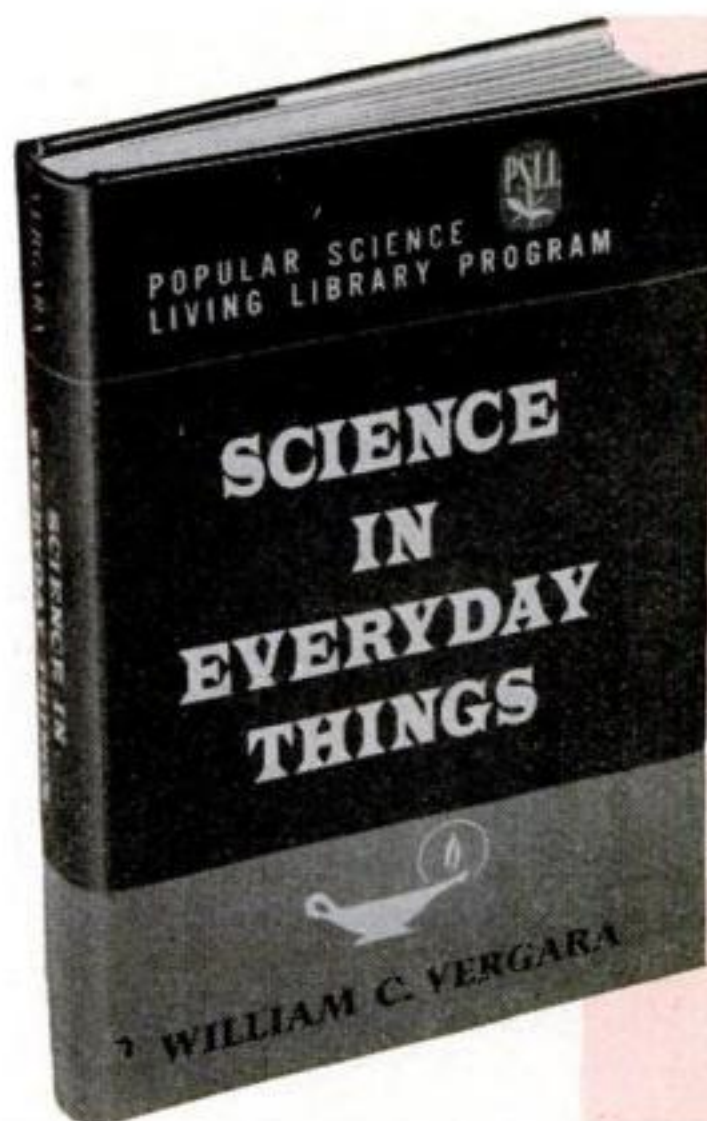
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the ground is weak. We could be knocked flat before we could strike back.

The answer is:

1. Replace the lox with an oxidizer that won't boil away if stored in the missile.
2. Fire the missile from its silo instead of lifting it first to ground level.

MISSILES like that—type II Titans—will go into the second batch of complexes at Tucson, Wichita, and Little Rock. They use “hypergolic” fuels—hydrazine and nitrogen tetroxide—which are innocuous liquids in their separate tanks but go *whoosh* when mixed together in the combustion chamber. They launch underground (it makes a ghastly racket but does not destroy the silo). They also have completely automatic steering built in and do not need to be controlled by radar from the ground. This means that Titan II missiles can be fired in salvo, three at a time.

Three Titan missiles make it a real big bang (the equivalent of more than 30 million tons of TNT). That's a worry. If an enemy hit should take out just one three-missile complex, we'd lose a big part of our arsenal.

That's where Minuteman comes in. It is cheap, dispersed, and very, very numerous. No conceivable enemy action could knock out more than a small part of this mighty strike-back force. The first Minutemen will be “in the green”—cocked for shooting—this year.

MINUTEMAN is a lot of little bits and pieces—as unimpressive as Titan is astounding.

Clinging to the side of one of those cliffs they call hills in Montana is what looks like a green-shingled house. It will never win a prize for architecture.

Inside are bedrooms, kitchen equipment, tables suitable for a roadside cafe, and a small elevator. The elevator goes straight down 50 feet. You walk through a blast door and you are inside a Minuteman control center.

It's not much bigger than a walk-in

closet. At the far end are huge hydraulic cylinders that shock-mount the floor against attack blast. Two men will stay here, watching the dials, 24 hours at a stretch.

That's it. The center controls 10 missiles, but there are no missiles here. They are scattered around in the vast wheat and barley fields, each one six miles or more away. The missiles stand alone in their holes, untended, marked only by their Cyclone fences and small signs—but connected to the control center by underground cable.

The Minuteman missile is preloaded at the factory with a synthetic-rubber fuel that burns like a sparkler and can blast the 33-ton bird out of its silo and toward target in 30 seconds. Steering is automatic and built in. Once the missile is winched down into the hole (from a gigantic semitrailer that stands up on end), it's ready.

When you put all the little bits and pieces of Minuteman together, it becomes very, very impressive. The 341st Strategic Missile Wing (the first of five Minuteman wings) will spread 150 birds and 10 control centers over 18,000 square miles of central Montana. That is an area bigger than the states of Maryland and New Jersey together.

THE ICBM crash program that began eight years ago is now drawing to a close. By 1965 the U.S. will be loaded for bear: 108 Titans, 800 Minutemen, 129 Atlases. Each can rocket faster than 15,000 m.p.h. to hit a target 6,300 miles away. Altogether they could deliver the blast of somewhere between two and four billion tons of TNT. That is just ground-based power. The “mix” of nuclear might also includes massive forces in the air (1,700 bombers) and in the sea (41 atomic subs, each carrying 16 missiles).

No more is on order. The Air Force is now aiming for space. Manned—and armed—satellites and space platforms would be the most effective guards anybody has yet thought up. ■ ■

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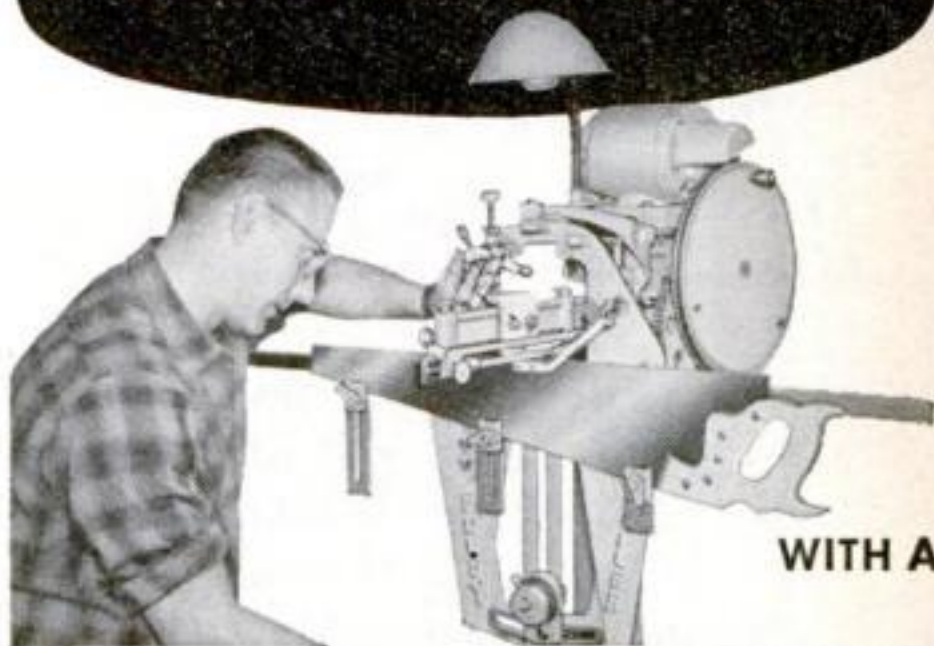
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What We Know About Pain

[Continued from page 43]

heavy price. Chronic pain can change a person's whole outlook; it becomes a consuming problem that dominates his life.

How much pain can a man bear?

There seems to be a built-in ceiling. Using their lamp-heat pain-measuring system, the New York Hospital researchers have found that when skin temperature gets to 152 degrees, pain reaches its maximum. It stays constant after that no matter how much more heat is turned on. Other studies indicate that if you're subjected to two or more painful stimuli at the same time, the most intense one will monopolize perception.

When is pain worst?

It's rare that any pain stays constant. Even cancer pain waxes and wanes. Generally, pain tends to be worse at night—because in bed, away from the distractions of the day's activities, you become more preoccupied with it.

Does pain affect your work?

Putting 26 men through a series of efficiency tests while they were subjected to various pain stimuli—hand in ice water, blood-stopping pressure cuff around an arm, painfully tight cap on the head—a University of Pennsylvania researcher got these results:

Pain, peculiarly enough, has no effect on tasks that primarily involve memory. Nor does it affect the speed of performance on mental tests—though it does increase the number of mistakes. It also impairs performance in muscular co-ordination tests. Overall, pain doesn't significantly change total work output, but it does impair body efficiency—your heart and other organs labor more to get a job done.

How do pains vary?

There are many types. In headaches, for example, pain can range from a severe throbbing to the feeling that there

What We Know About Pain

is a constricting band around the head. There are rhythmic types—like those associated with contraction of the uterus in childbirth. Some pains produce a sensation as of being pierced with a gimlet. Others are called “lightning” or “shooting”; they’re intense but momentary jolts. There are also aches—steady, nagging pains of low intensity. Cramps are muscle pains; they occur when a muscle or whole group of muscles goes into spasm, contracting involuntarily, knotting up.

What’s the most common kind of pain?

The kind you get from muscle spasm. It accounts for most everyday, garden-variety pains—many headaches, stiff necks, facial neuralgias, rheumatism, backaches, and a lot more besides.

In spasm, a muscle tightens up and won’t relax. You feel pain because the muscle may shut down its own blood supply, clamping down mechanically on the small end arteries that feed it. And the pain arises as the muscle starves for blood.

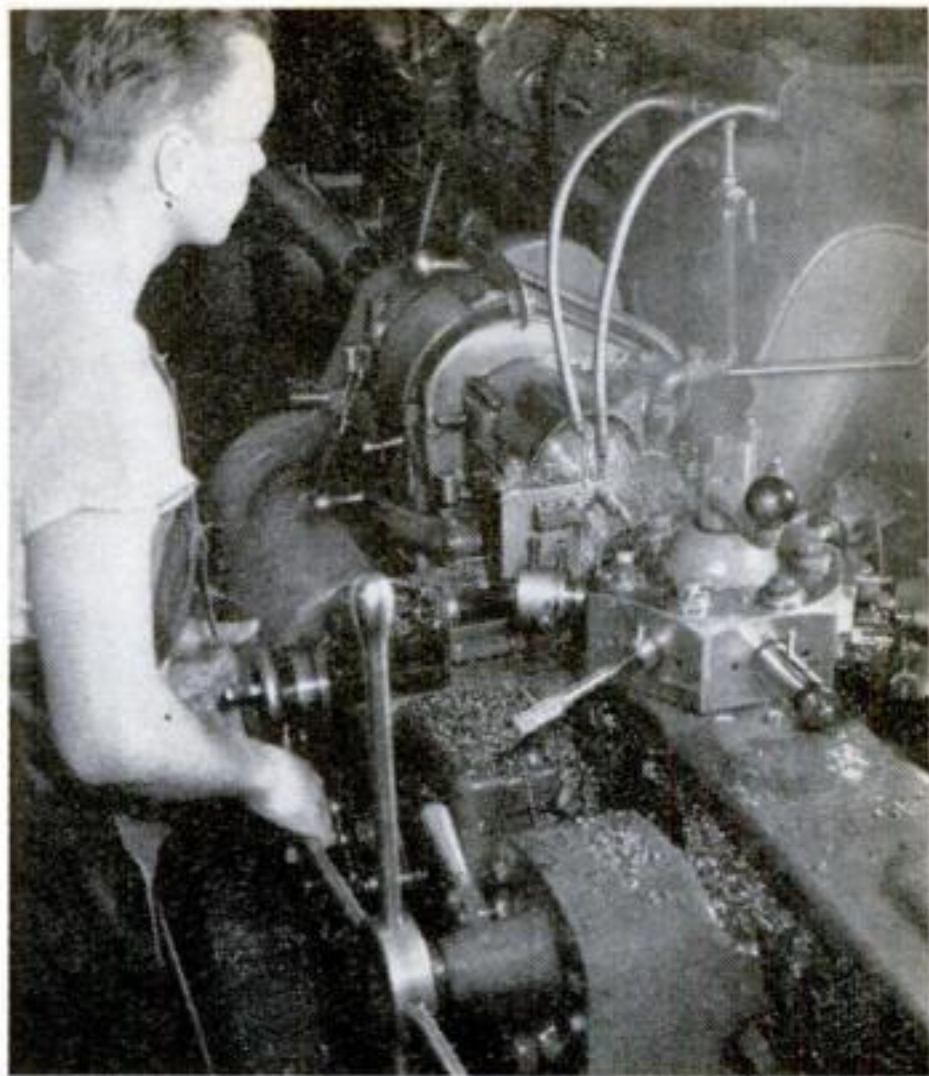
Spasm has many causes. Overexercising an “untrained” muscle can produce it. So can nervous tension, or sudden overstretching of a muscle—in a fall, for example. So, too, can sleeping in a draft, if the muscles are overfatigued.

How do pain relievers work?

Although the whole story still isn’t known, it’s believed that aspirin, carried by the blood, acts at a site in the brain where pain is perceived. In any case, it is known to decrease sensitivity to pain—enough, according to some studies, so that a pain stimulus has to be 35 per cent stronger than otherwise before you feel it. That’s true for other commonly used remedies for mild pain—such as acetanilid and phenacetin.

But the more potent—and addictive—narcotic pain-killing drugs, such as codeine, morphine, and Demerol, work another way. They act at a different site in the brain—where pain is interpreted.

CONTINUED



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What We Know About Pain

They alter reaction to pain, producing a state of euphoria in which all seems well. Although the pain is still there, you're only dimly aware of it.

How do anesthetics stop pain?

Anesthetics work in different ways, depending on type and how they are used. A general anesthetic depresses the workings of the brain and central nervous system. You go to sleep and, at the same time, the pain-perception mechanism in the brain is temporarily knocked out so you feel no pain. Local anesthetics such as novocaine, on the other hand, have no effect on the brain or central nervous system. Instead they work at the site of the injection, temporarily deadening the nerve endings so they transmit no pain impulses to the brain. If novocaine is shot into the spinal canal, it will block a specific pain pathway from some area of the body. An injection at one spot, for example, will knock out feeling in the abdomen and lower extremities. But since the brain is not affected, you stay awake and alert. Local anesthetics can also be used for regional anesthesia. Injected in various strategic spots, they temporarily block pain impulses from specific areas of the body.

How much pain should you put up with?

No more than you need to—and chances are increasingly good that you don't need to put up with any.

If aspirin or some other common remedy helps when you get an occasional headache or twinge, fine. And if a sore muscle responds to a hot pack, fine, too.

But if you suffer frequent pain attacks, get a physician to find out why. Chances are you'll feel better just for being sure of the cause—and, with the anxiety gone, feel less pain.

While there's still plenty for scientists to find out, enough is now known about pain and what produces it and how to relieve it so there's little need for trying to grin and bear it. ■ ■

The Back-Seat Driver of the B-58

[Continued from page 78]

like that of a woman ordering groceries over the telephone.

That was what the Air Force wanted—calm, unhurried, authoritative statements. Twelve women's voices and at least six men's voices were tested before a final choice was made. One girl lost out because she couldn't avoid sounding sultry. The Air Force didn't want pilots to think of anything but malfunctions.

The heart of the VWS is a unit you could easily hold in one hand. It consists of a 50-inch spool of inch-wide magnetic tape, a multichannel pickup, audio-amplifiers, and a small cluster of solid-state printed circuit boards.

There are 20 warning messages on the tape, in order of urgency, that cover a total of 50 faults. That's because several—such as "Check for engine fire"—apply to the same sort of trouble in each of the plane's four jet engines.

No message takes more than 15 seconds to deliver. It is repeated, however, until the ailment is fixed, or the pilot shuts off the announcement.

If one of the B-58's engines flames out while the VWS is giving a low-priority warning, the voice stops in midsentence and sounds the more urgent alarm.

This ability of the system always to give the most hazardous situation top billing stems from a remarkable bit of solid-state circuitry called a logic network.

It's this network that decides which warning message to play to the B-58's crew when a fault switch signals trouble. If several faults break out at once, the network picks the most dangerous to announce first, and lines the others up in order of importance.

The Voice Warning System also has a memory network. At the end of a mission, if there has been trouble, the pilot pushes a "Recall" button. The voice of Gina Drazin reminds him, for his flight report, of every doggone thing that happened.

The future possibilities for using the Voice Warning System are wide and

The Back-Seat Driver of the B-58

bright. Northrop's men, of course, think it belongs in every one of the more than 100,000 planes flying in the U.S. today—especially the jets.

Military fliers have already suggested applications that don't directly pertain to peril. For instance, they say, the VWS would make a dandy means of reading off a check list to the pilot of a single-place plane. That way, he'd never overlook any precaution before takeoff.

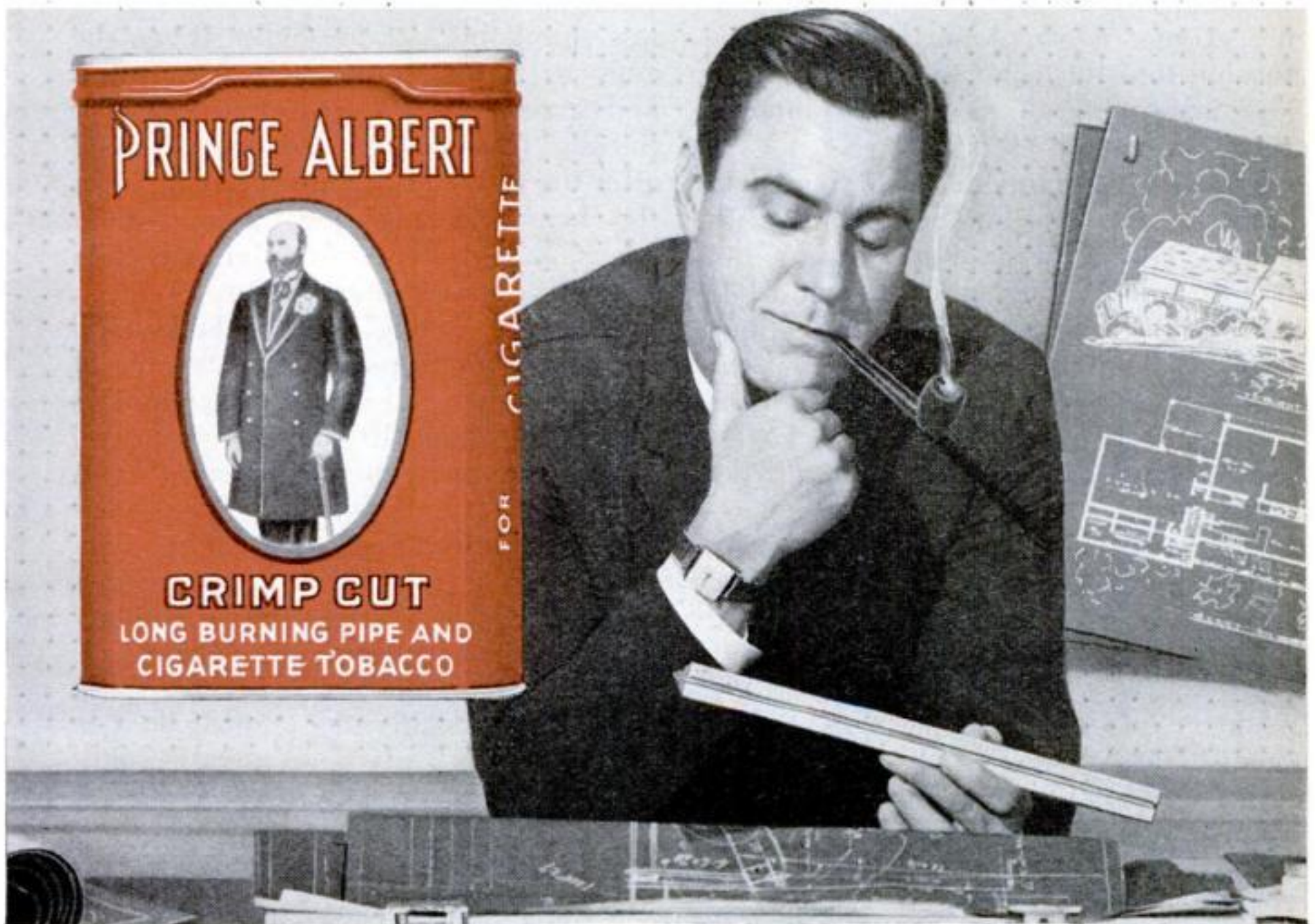
Northrop engineers propose using the

VWS aboard submarines, for missile-launch countdowns, and on big, complex industrial machines.

It is sad that Ray Tenhoff isn't here to realize what a clever inspiration he had on that tense day in 1955. He plunged to his death in Great Salt Lake in June, 1960, while testing a B-58 for Convair. Ironically, the Voice Warning System wasn't yet available. If it had been, Tenhoff's idea might have saved his life. ■ ■

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- Steam for her four big catapults—she can fire planes like a small boy shooting beans, with never a worry about running out of pressure.

- Electricity and to spare for her 1,255 tons of air conditioning, her 30,000 hp. in auxiliary motors, her 1,000,000 electron tubes, transistors, and diodes, as well as her general electric work load, equal to the needs of a metropolis.

Finally, the Enterprise’s reactors give her a dazzling turn of speed. (The printable figure is “in excess of 40 m.p.h.”) Among some of the crew she’s nicknamed the “85,000-ton hot rod.” If her skipper doesn’t want to waste time turning into the wind to launch jets, he just jizzes his throttles and launches them downwind.

I saw this happen. Two Skyhawks tried to give us the “split-level treatment.” Forming up way out, one of them came after us at 35,000 feet while his buddy came in directly under him, barely skimming the waves—so that the two planes looked like a single one on radar. To meet the threat, the Enterprise just speeded up and fired off her Crusader interceptors downwind, shooting from the hip.

Electronic decisions. But what may make this giant carrier the toughest fighting ship in the world is the electronic brain built into her Combat Information Center. Called the “Naval Tactical Data System,” it’s a package of diodes, transistors, memory circuits, and scopes. It collects battle information, split-second by split-second, from the radar picket planes, the ship’s own powerful radar, and other sources. It processes all the data with the lightning speed of a computer, and spits out crisp, deadly decisions to the Fighter Directors. It tells them which planes to go after, what kind of weapons to use,

where to steer, and when to fire—for each plane in the attack force. It even decides unerringly which of the enemy planes should be splashed first!

Enterprise still maintains an old-fashioned, human-staffed CIC room—one where sailors with grease pencils chart incoming raids on a plastic grid. But it’s only a back-up. “When you’re jumped by supersonic jets with air-to-surface missiles,” said Cmdr. Max Harnish, Executive Officer on the Enterprise, “the time it takes to grease-pencil a plot may be the time it takes for the enemy to squeeze off the bird that’ll kill you.”

If the Enterprise does sustain battle damage—and most ships in combat do, sooner or later—she’s ready. Not being honeycombed with smoke flues, she’s less vulnerable in a fire fight. When she goes to battle stations, sturdy water- and gas-tight seals are set up all over the ship by her heavy Z-doors. (Named after the shape of the linkage that works the heavy locking dogs around their edges, Z-doors seal off water, gas, fire, and radioactive contamination.)

All over her flight deck, flanks, and fantail are built-in sprinklers capable of wetting down all the lawns in Des Moines in about 10 seconds. Powerful pumps can pick up sea water in enormous gulps and sluice it over every exposed square inch of the ship. Reason: If a near miss by a nuclear weapon sends a deadly “base surge” of radioactive water and heavy mist fallout over the ship, the sluicers are already at work. The deadly hot stuff lands on running water, not bare metal, and is washed overboard.

On her hangar deck, the Enterprise has one of the most efficient fire-fighting systems of any carrier in the fleet. If a 600-gallon drop tank, full of fuel, accidentally falls and fills the hangar bay with withering billows of flame, a man need only press a button. Whereupon a blanket of foam falls from the overhead like an enormous rug—*plop!*—and in a

85,000-Ton Hot Rod

second or so, no fire. The jolly shipyard workers got the labels on the buttons mixed up, and on shakedown a chief pressed the button marked Auxiliary Starter Power. He got, instead, a foot of foam on his head—so they know the system really works, and fast.

Despite the mixed buttons, the officers on the Enterprise told me that they had never seen such a beautiful job of shipbuilding as was done on this nuclear warship. Constructed at the Newport News Shipbuilding and Drydock Company, the Enterprise is put together like a jewel—or a Mercedes 300 SL.

Everywhere aboard you see the deluxe touches that set this ship apart. On other carriers, hordes of carts and cables and hoses are trundled about—at considerable sacrifice in efficiency and launch speed—to feed AC, DC, and cooling air to the jets on the deck. The Enterprise has all these services neatly stuffed in receptacles on the flight deck; they just flip open a lid and hook up.

Her deck-edge elevators are floored with a lattice of alloy strips to make them lighter and faster. She can hoist a big A3J from the hangar deck to the flight deck like a waiter lifting a plate of ham and eggs, and almost as fast.

Naturally, there are a few troubles the seagoing hot rod hasn't licked. Her pagoda may not belch smoke, but it does set up tricky air burbles that can make life vivid for the pilots as they settle to the deck. Arrestor cables still break, despite inspection and preventive replacement. And some of the berthing compartments are also host to steam lines that can overpower the air conditioning.

But these problems, all subject to re-vamping, are trivial for a radical ship that is barely past its shakedown. If war comes, the nation, in my opinion, will get its last ounce of value out of this \$440,000,000 ship and its \$300,000,000 load of weapons. On its first try at war games, the Enterprise scored 90.26—the highest grade ever awarded an American carrier, and the second highest ever awarded any ship in our Navy. ■ ■

EVER HEAR A WHEEL BEARING BACKFIRE?

When an engine backfires, you know it. But a wheel bearing backfire sort of creeps up on you. After repacking, for example, you may notice grease leaking, or a clicking noise as you drive. The "click" turns to a "crunch" and the bearing soon crumbles. What went wrong? Was it repacked right?

CHECK THESE REPACKING HINTS

Handle bearings with care. Work with clean hands, tools and surroundings. Clean bearings with solvent and flush with clean kerosene. Lay them out on clean paper; keep lubricants clean; and clean the housing thoroughly before replacing bearings. Never spin dirty bearings and never spin bearings with compressed air.

Inspection. Examine bearings carefully for broken or cracked components; flaked areas; indications of overheating and brinelling. Replace if necessary. **Lubrication.** Use the correct lubricant; apply carefully to both bearings and housing.

Install new National seals. To avoid leaks that can ruin brake linings and cause premature bearing failure, *always install new oil seals.* Handle them carefully. Do not hit directly with a hammer. **Adjustment.** With ball bearings, snug only until bearing is seated and wheel doesn't wobble. With tapered bearings, tighten until wheel does not spin freely, but still turns before being backed off.

REPLACE WITH THE FINEST

Even the most careful service is only as good as the replacement parts. You'll be using the best with BCA Ball Bearings, Bower Roller Bearings and National Oil Seals because they're used as original equipment by automotive manufacturers. For longer service and dependability, stick with these three and you'll never hear a wheel bearing backfire.

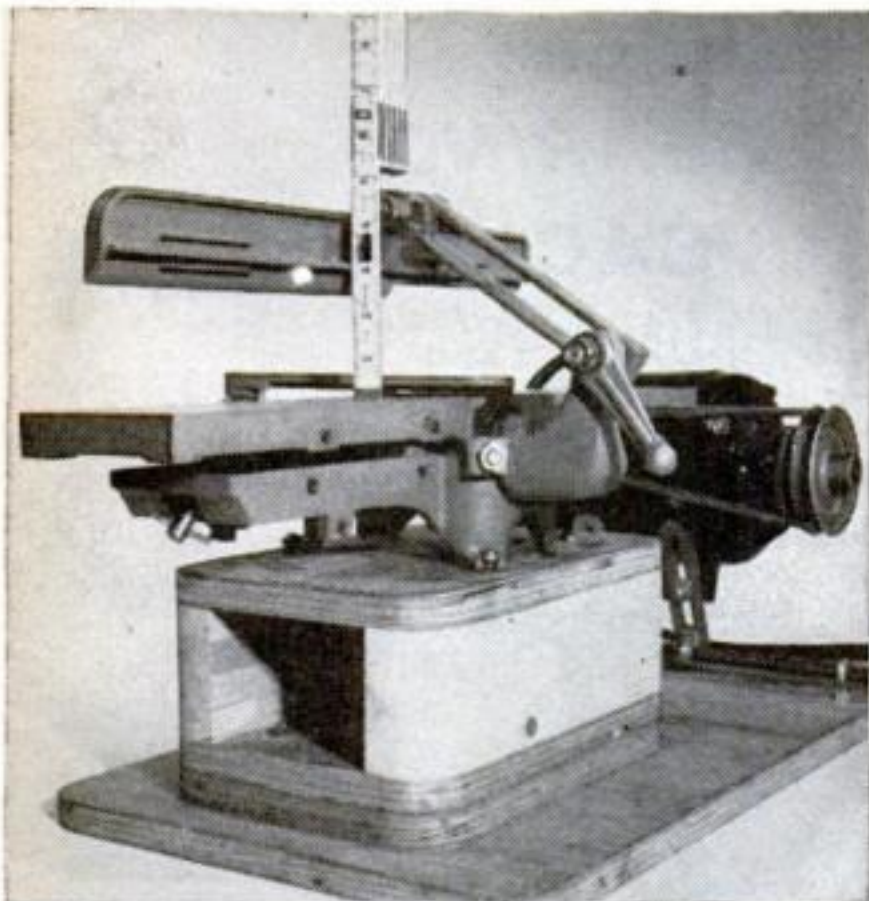
FEDERAL-MOGUL SERVICE

Division of Federal-Mogul-Bower Bearings, Inc.
Detroit 13, Michigan



Low-Cost Home Shop Tools

[Continued from page 109]



Unusual jointer fence pivots on a long arm, can be raised 4" to guide wide boards on edge. Jointer was blocked up on homemade base to permit this compact in-line motor mount.

impressive. At 1,725 r.p.m., it pushed $\frac{1}{4}$ " holes through $\frac{1}{8}$ " steel in four seconds, $\frac{1}{4}$ " steel in eight seconds, $\frac{1}{2}$ " steel in 17 seconds, $\frac{1}{2}$ " iron pipe in 20 seconds, and $\frac{3}{8}$ " solid-steel rod in 30 seconds.

You have to watch one thing: It's possible, under excessively hard feeding, to jam the bit dead. When this happens, the sudden backlash sometimes derails the long belt off the pulleys, and everything comes to a crashing stop. It's noisy, but harmless.

By conventional standards, the drill-press table is on the small side: 6" by 7". This is necessary, however, in order to let the table clear the column so it can rotate.

Clearance between the chuck and column is just under 5"—not as much as on most standard machines, but enough for average work. Checks on the table showed it to be square to the spindle in both front-to-back and side-to-side planes.

One beef: The chuck is stated to have $\frac{1}{2}$ " capacity, but the jaws are actually a shade too small to take $\frac{1}{2}$ "-shank bits. The chuck is also a simple hand-tightening affair, although this was not found to be a problem. All bits held tight, even when forced hard in metal. The spindle has a standard $\frac{1}{2}$ " threaded shaft so you can substitute a geared chuck if you prefer.

A new model of the drill press, to be introduced this fall, is reported to have many

of the same conveniences plus two added attractions: It will offer greater capacity and have a radial-mounted spindle head that can be tilted to drill angled holes. It's designed to sell in about the same price range, and sounds like a real up-and-comer.

Testing the table saw. The first thing you notice is a curious blind spot in the saw's table. As you tilt the arbor to make bevel cuts, the blade rises, as shown in the drawings. This is good—except for one problem. As the blade comes up, it bumps smack into a projecting shoulder at one end of the table slot. At 45 degrees, this stops the blade at a maximum cutting depth of $1\frac{15}{16}$ "—too little to miter 2" stock.

We checked with the manufacturer on this point and were assured that it will no longer happen on new saw models. In any case, for anyone who may encounter the problem, it's interesting to note that there's a simple cure. It takes only a minute to file away the offending shoulder, permitting the blade to rise all the way to its hub. Take a look at the two depth-test photos and you can see what an important difference this makes. With the shoulder removed, the blade is free to cut a full 2" depth at 45 degrees. (In the saw shown, a small portion of the arbor shaft was also removed to keep it from striking the work.

Perfect miter joints were made repeatedly, but with the help of a try square to set the blade at a precise 45 degrees. The saw's tilt scale was found to require occasional readjustment.

In crosscut tests, the saw sliced through 4" widths of $\frac{3}{4}$ " pine in $2\frac{1}{2}$ seconds, $\frac{3}{4}$ " plywood in $3\frac{1}{2}$ seconds, and $\frac{3}{4}$ " maple in $4\frac{1}{2}$ seconds—all very close to similar cutting times obtained on a standard shop saw of equivalent size and power. A two-by-four took a bit longer—seven seconds.

On rip cuts, the saw easily handled both $\frac{3}{4}$ " pine and $\frac{3}{4}$ " plywood at a rate of about 13 seconds a foot. A little drag was noticed on long cuts in hardwood— $\frac{3}{4}$ " maple took 23 seconds a foot.

For large work, the saw's table is admittedly small: $10\frac{1}{4}$ " by 13". Both side and front extensions are available, however, and you're sure to want them for any kind of panel cutting. Maximum table area with three extensions is 18" by 21".

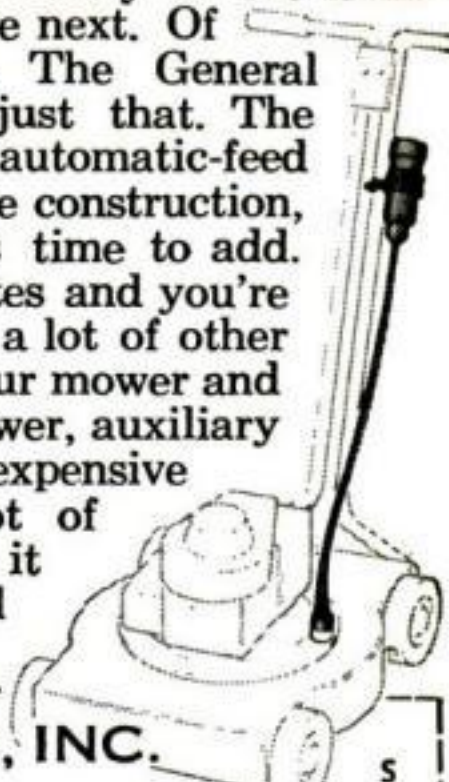
Minor annoyances: You pay an extra \$3.50 if you want a rip fence, a basic need.

Harry's

Saturday just went up in smoke



What happened to Harry could happen to you or me or anybody. Wheeling out the power mower to make a quick pass at the lawn, he never gave the crankcase oil level a second thought. The tragic result is that smoking ruin at Harry's feet... motor and bearings burned to a crisp. Unhappily, this sad and costly scene is repeated a thousand times over every Saturday of the Summer. Maybe you've had your turn, maybe you're next. Of course, the whole business can be prevented. The General Plastics MOT'R SAV'R is designed to do just that. The MOT'R SAV'R provides you with an auxiliary, automatic-feed oil reservoir which, because of its unique construction, lets you know at a glance when it's time to add. Install it on any mower in two minutes and you're set for years. Works just fine on a lot of other 4-cycle motors too. Slip it off your mower and onto your garden tiller, snow blower, auxiliary generator or what have you. Inexpensive too. Just \$4.95. Makes a lot of sense when you think about it... good Saturdays are hard to come by.



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Low-Cost Home Shop Tools

A miter gauge comes with the saw, but has an unmachined face. There's only one miter-gauge slot and it's to the right of the blade.

The jointer—a bit finicky. Because of the table's design, it's not possible to make cuts any shallower than $\frac{1}{16}$ "—a pretty big bite for simple surface smoothing. This is no problem on softwood. The tool easily edge-joints $\frac{3}{4}$ " pine at a rate of four seconds a foot—as fast as you can push the stock through. It will also square a fir two-by-four with a single pass on each face, completely removing the rounded corners.

On hardwood, however, you need a slow, gentle feed or the blades will stutter and produce a rough cut. One possible reason: The cutting head contains only two blades instead of the more common three.

Maximum cutting depth is $\frac{3}{8}$ ". At this setting, the tool easily whacked the grooved edge off tongue-and-groove pine in a single pass. It slowed slightly at knots, but planed them smooth without chipping. It also cut $\frac{1}{2}$ "-by- $\frac{1}{4}$ "-deep rabbets in both fir and pine at a rate of 20 seconds a foot—pretty good going.

The jointer tested had one shortcoming that will not appear on newer models available by the time of publication. The fence, a rather hard-to-adjust affair, will be redesigned to simplify alignment.

What do you give up? The tools can't be expected to do the work of machines costing \$100 or more—and they don't. What they do offer is an economical way of handling many average home shop jobs. They're light, portable, and easily storable—a good bet for the home owner with limited shop space. We personally fell in love with the little drill press, top performer of the three.

What you give up is a certain amount of speed, convenience, and heavy-duty capacity. Adjustments take some fussing. One obvious economy is in the sleeve-type bearings. Although no wear was detected during the tests, the bearings do get hot and frequent oiling is recommended. In time, they may need to be replaced. A ball-bearing version of the saw is available for an extra \$5 and seems like a wise investment.

To back up its claims, the American Machine & Tool Co. offers a 10-year guarantee with each tool. Considering what you pay, the machines, in our opinion, give surprisingly good value. ■ ■

Home Movies That Talk

[Continued from page 143]

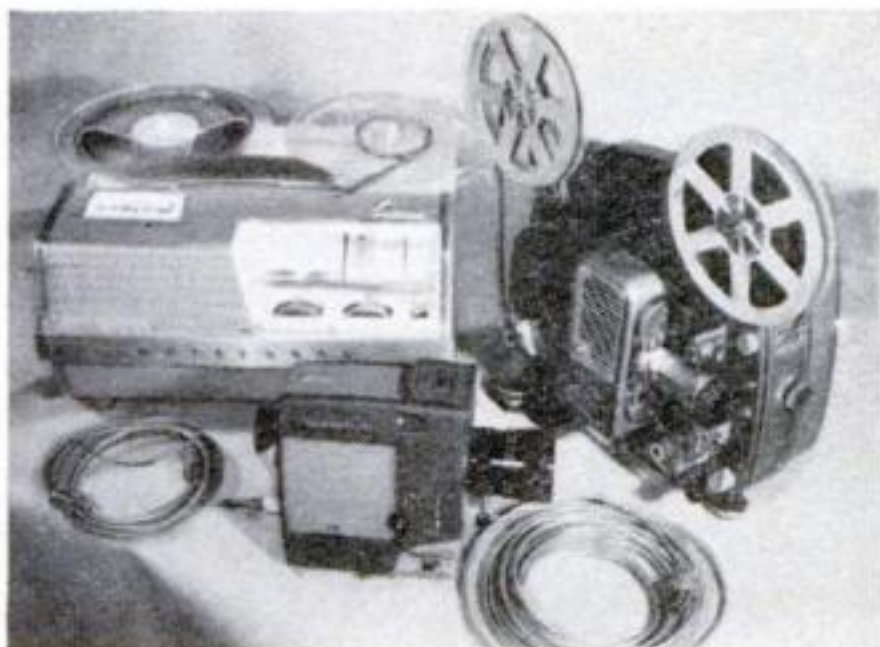
require a sound to occur at precisely the same place in the film each time.

One advantage of the tape-recorder method is that it lets you start out gradually, then add more advanced equipment later without wasting anything. If you eventually go in for a sound projector, you can have your film striped and transfer your original sound track to it right from the tape—all in one piece.

A tape recorder is also a big help in making sound tracks even when you have a sound projector, because it simplifies editing. One problem with sound projectors is that their recording head is spaced some distance from the projection lens (usually 56 frames). This means that the sound for one scene is actually opposite another scene.

If you snip out one section of film, you end up removing the sound track for another section that you want to save. With a tape recorder, you can cut, add, or rearrange parts of your sound track without disturbing the film. When the sound track is perfect, you transfer it all at one time to the sound stripe on the film.

The ultimate: synchronized sound. Where you want to record people's voices, the bang of a door closing, or other such sounds that must occur at a precise point in the film, you need some way of keeping your sound track in exact step with the picture. Called lip sync, this is the tops in professional technique and is now avail-



Packaged sound systems enable you to buy prematched camera-recorder-projector combinations. During filming, the camera records timing pulses on an unused tape track. At playback, the pulses keep the projector at a matching speed. Michael DeAngelo, 146-29 Laburnam Ave., Flushing, N.Y., sells the packages for about \$700 up, will also adapt your own equipment for synchronized sound.

CONTINUED

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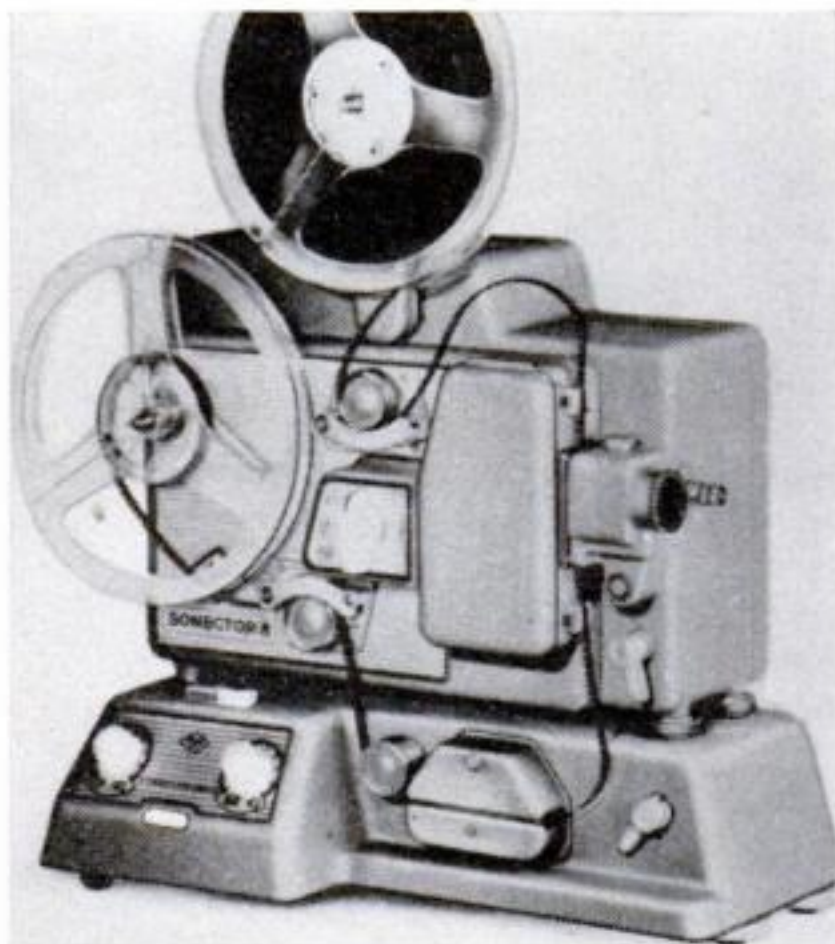
Home Movies That Talk

able to home moviemakers in 8-mm. form.

Fairchild's new 8-mm. sound camera, a one-of-its-kind, lets you record voices and other sounds at the same time you take the picture. The sounds are magnetically recorded on prestriped film by a recording head built into the camera. The film, after developing, is shown in a sound projector for playback of the sound track.

There are also several ingenious gadgets that enable you to synchronize a tape recorder with either a silent camera or silent projector to provide precise matching of sound track to film. These are called sound couplers. They use the tape recorder's drive mechanism as a timing device to keep the camera or projector at the same speed.

With this kind of setup, you can make



Even professional tricks, such as sound-on-sound recording, are possible with 8-mm. sound projectors. The film is recorded once, then can be run through a second time to superimpose added sound effects. This Agfa sound projector sells for \$389 from Agfa, Inc., 516-20 W. 34th St., NYC.

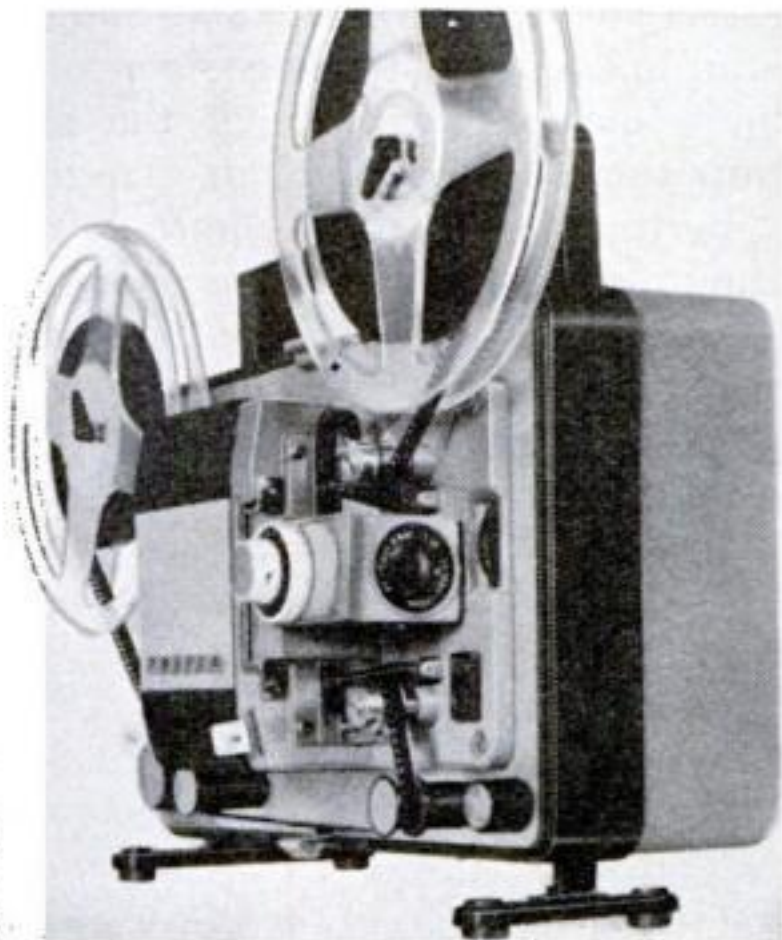
a sound track in two ways: You can couple a tape recorder to a camera and record actual voices at the time you take the picture. Or you can couple the recorder to a projector and add your sound later while watching the film on a screen. In either case, the coupler is also used whenever the film is projected so that the sound track will always play back exactly as it was recorded.

Home Movies That Talk

Sound couplers work basically in two ways. In one type, the recorder sends electrical pulses to the projector or camera to control the motor's speed. The other type provides a mechanical connection in the form of a flexible shaft that links the recorder motor to the camera or projector motor.

A few projectors, like the German-made Bauer, have built-in provision for attaching a sound coupler. You can also have couplers fitted to most types of cameras, projectors, and tape recorders that do not have such provision. Companies like Movievox in San Antonio, Tex., and Michael DeAngelo in Flushing, N. Y., will take your present silent equipment, perform a bit of surgery on it, and return it to you ready to make sound movies. Prices range from about \$75 to \$150 depending on the type of coupler you choose.

Commercial moviemakers, quick to hop on the amateur's bandwagon, are now supplying professionally shot films of historic and scenic attractions in 8-mm. size. The idea: You splice them right into your own shots of the same subjects and nobody knows the difference. You even get a sheet of historical facts with each one so you can make up your own authoritative-sounding narrative. Cheating? Well, just a little. ■ ■



A built-in stroboscope lets you manually synchronize this silent Fujica projector with a tape recorder by adjusting its speed control. Price is about \$120 from Fuji Photo Optical Products, 111 Fifth Ave., NYC. A full sound projector is available for about \$350.

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188 POPULAR SCIENCE JULY 1962

The Job That Scares Everybody

[Continued from page 72]

rope and pulley, a man standing by the tractor cab pulled the sled gently forward in the cage. Sweeney got back to locker 9217 to find Detective Mulligan peering at the pipe. "I'll take this one," said Mulligan.

About this time two men hauled in the bomb bag.

This is a steel-cable mat six feet square that can be folded into a bag. It is so heavy that it must be carried by two men, hung between them on steel poles.

Mulligan now began to probe in the locker. He moved the newspapers and, finding no further hidden apparatus, reached in with both hands. He grasped the heavy metal pipe and lifted slowly. A bit more of the black stuff dribbled out, and it occurred to him again that it could all be a gigantic hoax. But he spared no pains.

When the steel pipe was a couple of inches above the locker bottom he drew it out and, after an infinity, had it in the bag. He breathed an audible sigh when O'Neil at last closed the chain mail over the thing and clamped the bag shut. Then Mulligan and Sweeney shouldered the steel poles and, with the bag hanging, like an opossum that feigns sleep under a limb, moved out through the shop.

Now they faced a problem. To get to Big Bertha they had to climb down a loading-platform ladder. This meant tilting the pipe. Here the Emergency men came to the rescue, reaching up to take the load on their own shoulders. Gently, the transfer was made, and the pipe, still in its bag, was lashed to the bottom of the big cage directly underneath the vial and its grid.

O'Neil told the Emergency men: "Drive evenly. Don't jostle this one." He didn't want to slosh the liquid, whatever it was, in that tube.

He sent a message to the Army at Fort Tilden: "We're coming down. Please prepare pits."

Quite a parade now formed. It is 10 miles out to Fort Tilden and it would be impossible to empty the city streets

The Job That Scares Everybody

for that distance. So Big Bertha and its load went through miles of thoroughfares lined with people who heard the procession coming. Motorcycles shrilled, stopping cross traffic. Behind, came a wailing police car, an Emergency car, and Big Bertha, growling like a thunderstorm. At the tail were the B Squad men and another Emergency car for rear guard.

Top brass had been notified. At each precinct, fresh escorts met the parade to guard against possible collision with cars or trucks. At 11:45 a.m., the cage lumbered into Fort Tilden.

The Army had pits ready. The detectives lowered the pipe into one, the vial into another. A blasting cap was put in the first pit with the pipe and everyone retired to a bunker behind slit windows.

Would the object prove a fake?

JUST before noon, O'Neil gave the word. The cap in pit No. 1 ripped loose a crackling puff. Suddenly the pit erupted with a roar. A plume of black smoke flew up. In the reverberations from the bunkers the B Squad men clearly heard the characteristic *ga-room!* of black gunpowder. They tried to visualize what might have happened in Grand Central.

"That bomb," Schmitt said to O'Neil, "could have killed 20 people."

They tried the vial next. There was an ear-splitting *crack!*, a shuddering blast that rocked the bunkers, and a geyser of sandbags flung high. As the cloud settled, Schmitt turned again to O'Neil: "One thing's for sure. That wasn't 3-in-1 oil."

FROM fragments, the bomb has been reconstructed. They haven't caught the man who made it. "But we will," says O'Neil. "We will."

It was 12:50 when the crew, tired but exhilarated, got back to the squadroom. The phone was ringing. Detective Don Cerbelli, ex-Army demolitions man, took it. CB was calling. "Someone just found a package on a doorstep. They think it's ticking . . ."



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How Old Is It?

[Continued from page 88]

other system. They're peeling back the years by measuring moisture depths on the surface of obsidian, a volcanic glass used in old arrowheads and knives. It gives rough estimates of dates.

After buying an ancient obsidian mirror in Mexico, an American collector found that many similar mirrors had been mass-produced in the back country. Was his authentic? He sent it to Clark who, with the help of an 800-magnification microscope, found that moisture had diffused 1.6 microns (about 6/10,000 of an inch) into the surface. The mirror was more than 500 years old. The collector could relax.

The atomic clock. The famous carbon-14 test of UCLA's Dr. Willard F. Libby has dated thousands of living things. Here's how it works:

1. Cosmic rays bombard the upper atmosphere, forming radiocarbon (C-14). This combines with oxygen to form an offbeat kind of carbon dioxide that's radioactive.

2. Radioactive carbon dioxide diffuses evenly through air (as it has for millions of years) and is absorbed with normal carbon dioxide by plants.

3. Animals eat the plants. Result: Every living thing contains a specific percentage of C-14.

4. When living things die, the C-14 in their systems begins to decay.

5. By comparing the remaining carbon-14 in their systems with the regular carbon-12 in, say, ancient carbon or shell, you can compute the date of death.

The Atomic Clock determined the age of linen that bound the Dead Sea Scrolls—33 A.D., plus or minus 200 years. Prof. John Lyon of Dartmouth College used the method to measure the age of ancient tree stumps still rooted in Nova Scotian tidal lands. Armed with these birth certificates, he calculated that the sea is rising one foot every 55 years.

Good as C-14 testing is, there's still margin for error. (Isotopes, Inc., Westwood, N. J.—one of the few commercial labs doing C-14 dating—usually allows

How Old Is It?

for a built-in error of 350 years or so for a 10,000-year sample.) Nonorganic matter, of course, can't be tested at all.

If you want a relative, but not an actual age, there's always fluorine dating—built on the fact that bones lying on the ground gradually absorb fluorine from the soil. The absorption rate, of course, depends on the kind of earth.

This is the technique that exposed what was probably the world's most famous hoax. In 1911, English workmen building a road dug up parts of a fascinating skull. With a head like a man and a jaw like a monkey, it was hailed as the long-sought missing link. Most scientists doubted that the creature was a bridge between ape and man, but nobody knew for sure and the Piltdown Man even got into science books. Almost 40 years later, it was settled. Fluorine in the skull proved the head to be a true fossil, a human skull thousands of years old. The jawbone? It had virtually no fluorine at all. Someone had put it there to be found—just the jawbone of a chimpanzee.

How old are we? But we do know something about the age of the human race. Man is at least twice as old as anyone figured.

In 1960, Dr. Louis S. B. Leakey, curator of Coryndon Museum in Kenya, found sections of the skull and legs of a manlike creature in northern Tanganyika. He called the fellow *Zinjanthropus boisei* (Zinj for short). Along with Zinj were a few crude stone tools.

How old is he? Dr. Leakey's first hesitant guess was "something more than 600,000 years." To prove it, the doctor sent volcanic ash—found both over and under Zinj—to Dr. Garnish H. Curtis at the University of California. Results of the early tests were startling. Dr. Leakey had made one of the most astonishing finds in decades and Dr. Curtis had come up with the most dramatic fact to come out of potassium-argon testing. The average age of the samples dated so far—1,750,000 years. That's Zinj. And his few crude tools prove he was a man. Only men use tools. ■ ■

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Last Chance to Save the Bald Eagle

[Continued from page 101]

tinued. The latest one came from a Columbia University historian, Richard B. Morris, who called the bald eagle "lazy, cowardly, rapacious, and hardly a fit national emblem."

Ornithologists and naturalists will have nothing to do with the sentiments expressed by Benjamin Franklin or historian Morris. To them the bald eagle is a wild creature, not a symbol burdened with man-made inhibitions and morals.

A mighty hunter. The hungry eagle soars restlessly over land and water. When he sights his prey, he drops like a stone until a few feet from his unsuspecting victim. He levels off with a miraculous braking action and seizes his meal with needle-sharp talons. Then, with a powerful flapping of wings, he rises slowly to head back to his perch.

He usually dives at 60 miles an hour, but eagles have been clocked at an astounding 100 m.p.h.

If his speed is amazing, so is his vision. One eagle was observed to head for a fish floating on a lake a full three miles away. His dive took him straight as a rifle bullet to his target.

Eagles mate for life, building their massive nests high on top of trees. One nest near St. Petersburg, Fla., measured 9½ feet in diameter and 20 feet deep. It weighed more than two tons.

Each year the eagles return to their nest, adding to it, stick by stick. It takes extreme provocation to drive them away. During World War II, a pair of eagles refused to leave their nest, even though it was in the middle of a bombing range.

In summer, the eagle roams the continent searching for food and a place where he'll be left alone. Birds banded in Florida have been found in northern Maine; some banded in New England have turned up in the Midwest.

Of course, the *real* eagle area is Alaska. It has so many eagles that until 1952 there was a bounty of \$2 for each dead one. It was a shameful bounty, backed by hunters and fishermen who claimed the great birds were destroying

foxes and salmon. These claims eventually were disproved, but not before more than 100,000 eagles had been killed.

Eagles lay one or two eggs at a time. The eggs, only three inches long, can be dull white to pale blue.

Once the eaglets are born—tiny balls of white fuzz—the adult eagles prove that birds can be as protective and solicitous of their young as humans. They'll rip food into bite-size pieces for the eaglets and stand ceaseless watch over the eyrie.

Despite this attention to their young, bald eagles have come in for a lot of criticism for their failure to protect their nests from intruders.

Cowardice?

Or have the eagles learned that the price of survival is to remain out of gunshot range—that man is his one enemy?

The free and the brave. Without question, the bird has proved his courage and fierce fighting ability on countless occasions. One naturalist reports finding an adult male eagle caught in a trap, the bird doomed. The naturalist attempted to end the bird's misery with the only weapon at hand—a large tree limb. With the first blow, the tortured bird rose in fury and, dragging the trap behind him, went for the man, taking blow upon blow, until finally beaten down for the last time.

Eaglets show signs of inherited scrap-piness at a very early age, roughhousing with a brother or sister, if they have one.

It takes at least three years before they show adult markings—the typical white head and tail feathers, the golden beak and legs. The young bird is brown like the golden eagle, a bird not protected by federal law.

That creates a further problem—of mistaken identity. The legal killing of the golden eagle is helping to push the bald eagle into oblivion. To stop this mass murder of both species, the Audubon Society is seeking legislation that would make it illegal to kill the golden eagle as well. ■ ■

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compromise. He wants you to get some kind of picture—good, if possible, but in any case something that will print—and he knows that it's always safer to expose too much than too little.

Take Verichrome Pan. It has a recommended exposure index—the guide that tells you how much light a film needs—of 125. This is a fairly low number, giving you the impression that the film is pretty slow and needs a lot of light. Yet I, an average photographer, consistently shoot it at 320 with no special developing, and the negatives print beautifully. When you shoot Verichrome Pan at the recommended 125, you are giving it $2\frac{1}{2}$ times as much exposure as it really needs.

This is called latitude. It doesn't necessarily mean that you'll get good pictures over a wide range of exposures. What it means, pure and simple, is that you can abuse the film outrageously and still get some kind of picture.

But why abuse it? Why not use it the right way? If your negatives are thick and your prints tend to be all blacks and whites without much middle tone, you will get better pictures by doing one of two things:

1. Increase your shutter speed, which will cut your exposure and actually give you sharper pictures in the bargain by reducing camera motion, or . . .

2. Switch to one of the finer-grain, extra-quality films such as Panatomic-X for all outdoor photography. These *need* more light, are less likely to be overexposed, and at the same time produce clearer, sharper pictures. They're also the answer for cameras that do not have variable shutter speeds.

Too little light: another problem. While you can overexpose an all-purpose film ruthlessly, latitude does not help you much on underexposure. When you reduce exposure too far, there just isn't anything on the negative from which to make a print.

In good light, all-purpose films are faster than you think, but they fall off quickly when the light grows dim. That's why, in poor light, you should switch over to a high-speed film—Super Hypan or Tri-X—that thrives on darkness.

Here again you'll find the film maker far on the conservative side. Recommended exposure index for Super Hypan is 500. Yet it's routinely shot at 1,000 with normal

developing, and can be pushed as high as 5,000 with special developing.

Such light sensitivity means you can photograph your grandmother knitting under a bridge lamp. A normally lighted living or dining room is bright enough for snapshots without flash bulbs or other supplementary light. If your lens will open up to $f/3.5$ or so, you can probably shoot your friends at the bowling alley.

You may wonder: Why isn't Super Hypan or Tri-X the true all-purpose film since it can make pictures where other films can't? The answer: There is absolutely no place for a high-speed film out of doors in daylight. It just won't give you the quality you get from the regular all-purpose films or the slower fine-grain ones. Fast films go all to pieces when they are overexposed, leaving you with grainy negatives that have poor definition and print badly. And, unless your shutter will go up to $1/1,000$ of a second or stop down to at least $f/22$, you'll probably overexpose a high-speed film on a sunny day.

Watch those flash bulbs. When you shoot flash pictures indoors, you're also better off with a slower, fine-grain film like Panatomic-X. Even the all-purpose films are too fast here. Check your flash-exposure guide numbers and you'll find that, with the average camera, you can't stand closer than about eight feet from the subject without overexposing so badly that the negative won't print.

Cross-check this with your recommended outdoor exposures. You may be surprised to learn that at about 10 feet a No. 5 or No. 25 flash bulb is as bright as the sun.

How about special processing? It's possible to make a film do tricks if you have access to special developing. Unfortunately, this is normally available only to the photographer who does his own darkroom work or at a few high-priced custom-finishing houses. Drugstore-type processing is a highly routine operation, and often the developers used are as all-purpose as the film.

So it pays to pick the right film for the job instead of straining the wrong one. With a selection of only three films—a slow-speed fine-grain, a medium-speed all-purpose, and a high-speed—you can cover any picture-taking situation and come up with top-quality photos every time. ■ ■



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